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Natural Resources of
ARIZONA

Prepared by the - United States Department of the Interior - Stewart L. Udall, Secretary

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The purpose of this booklet is to bring a new awareness to the American people of our rich natural resource heritage, its history, its present, and its future. To know our land is to love it and cherish it and protect it from the ravages of both nature and man.

Stewart L Udall

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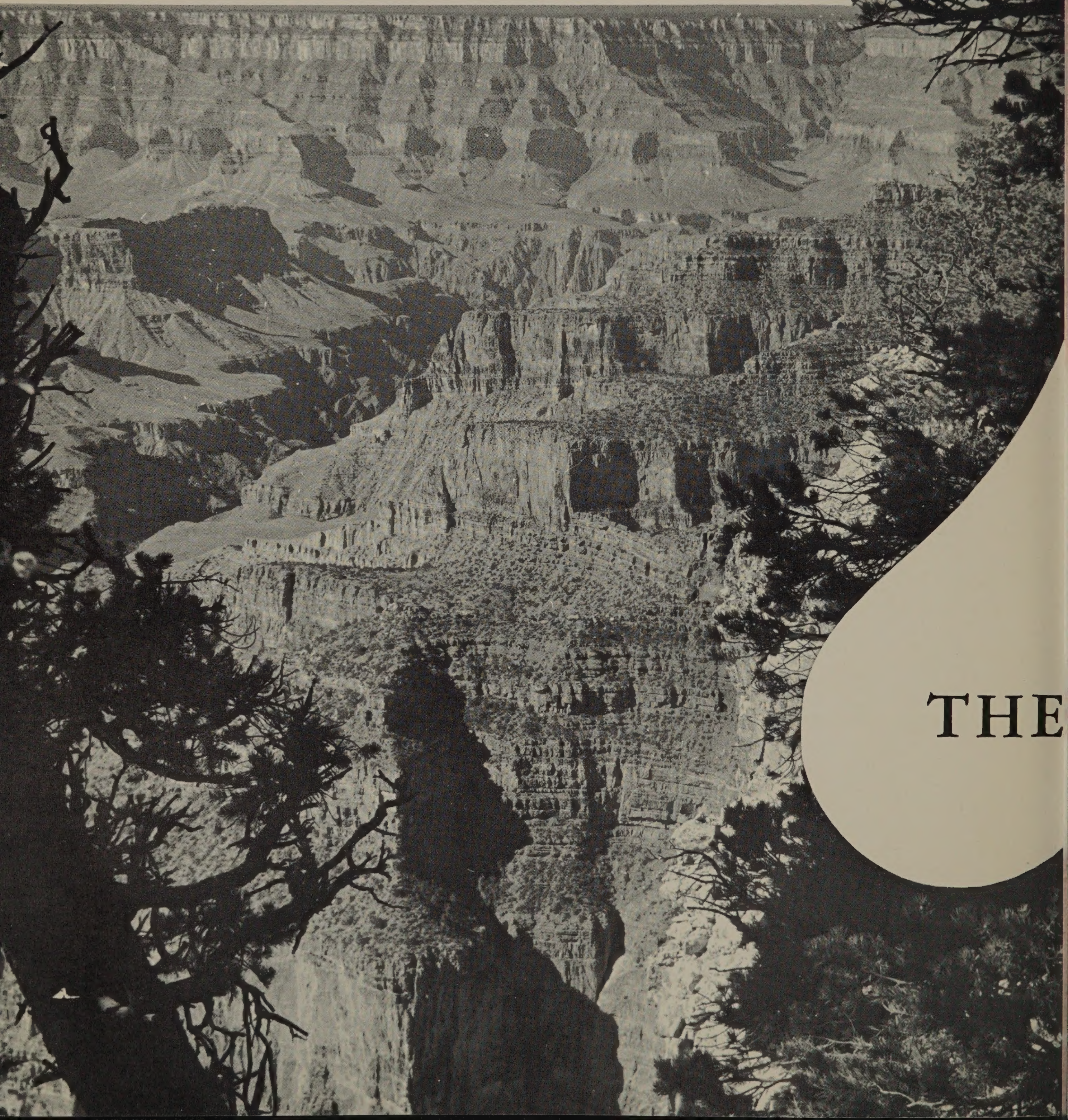

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NATURAL RESOURCES OF ARIZONA

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Ruins of an earlier civilization in Arizona's fascinating history are preserved at the Wupatki National Monument.

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Table of contents

Page

Introduction and History 1

Physical Characteristics of Arizona 3

Park and Recreation Resources of Arizona 5

Fish and Wildlife Resources of Arizona 11

Water and Power Resources of Arizona 15

Mineral Resources of Arizona 19

Land Resources of Arizona 21

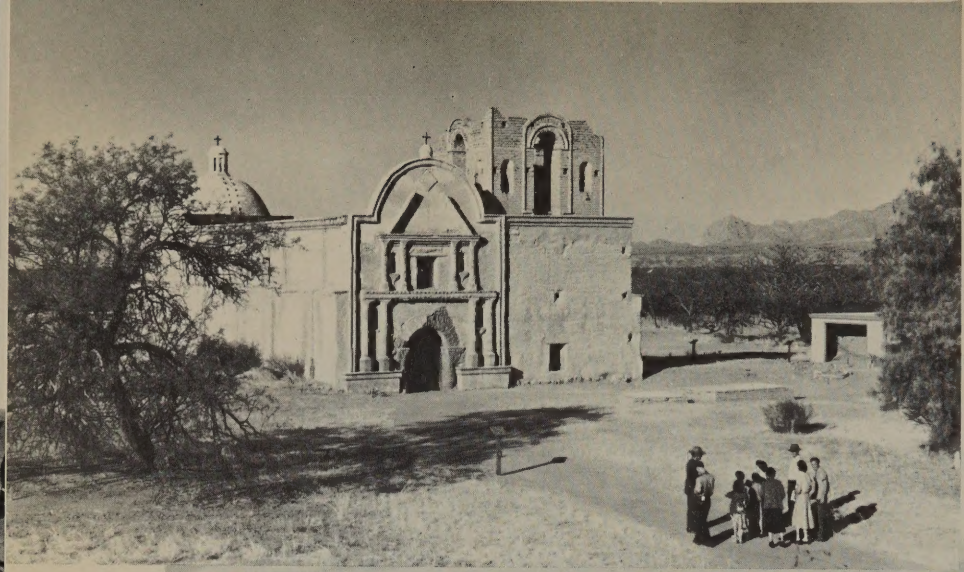
Indians of Arizona and their Resources 27

Geologic Sketch 33

Programs of Federal Natural Resource Agencies

Bureau of Reclamation 35
Geological Survey 39
Bureau of Mines 40
Bureau of Indian Affairs 41
U.S. Forest Service 41
Bureau of Land Management 44
National Park Service 46
Fish and Wildlife Service 47
Bureau of Outdoor Recreation 48
U.S. Army Corps of Engineers 49

Summary 52

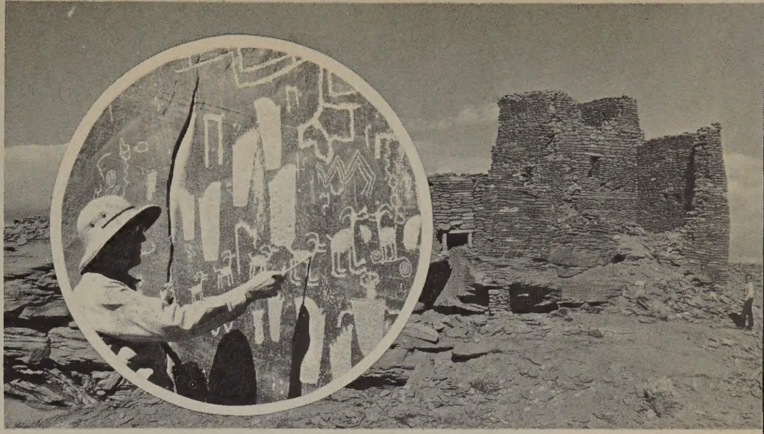


Visitors are guided by an historicn through Tumacacori National Monument, one of several Arizona units of the National Park System reflecting the historic past of the State.

Colorful Arizona is a land of contrasts with great plains and plateuas of multi-colored earth.

Giant sahauro cactuses grow on the desert near Phoenix. The white waxy blossom that appears each spring on the tips of the arms and trunk of the cactus is the State flower.

Introduction and History



ARIZONA is a land that evolved out of a myth—and the reality has become greater than the dream.

In the early days of the 16th century, the Conquistadores, under Coronado and other Spanish leaders, came up out of Mexico in search of the fabulous Seven Cities of Cibola, where the streets and walls were said to be made of gold and precious gems.

But the Conquistadores never found their golden cities and they were unaware of the true and tremendous wealth of Arizona that lay beneath their feet.

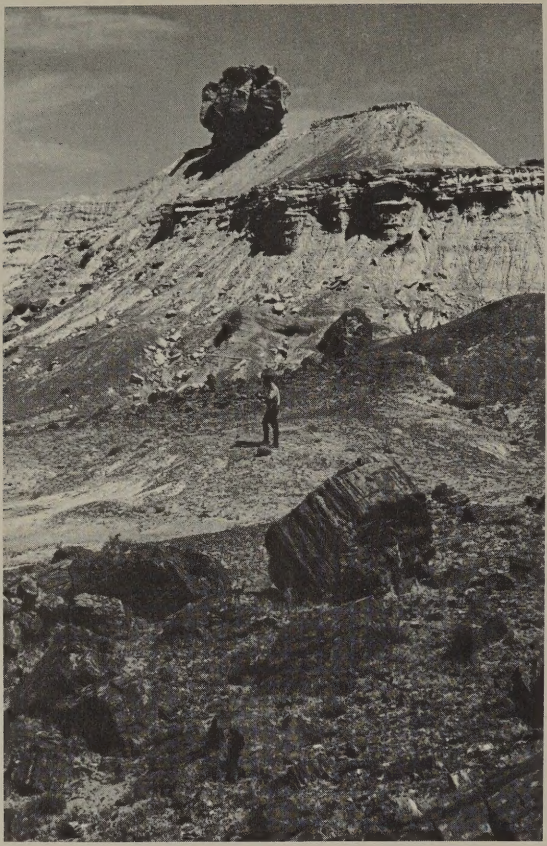
Organized as a territory in 1863, admitted to the Union in 1912, Arizona is the Nation's third youngest State, and alive with the spirit of youth. Yet if we count the eons through which it has been inhabited by man, civilizations that have come and gone, Arizona is an ancient and venerable land.

Arizona has been the home of aborigines who stoned to death the giant sloth and other strange prehistoric beasts; of nomads only a little more advanced who huddled in natural caves, hunted with spears and bows, yet developed an art of basketry not surpassed today; of cliff dwellers who built shelters of stone and learned how to shape clay into pottery; of pastoral tribes who built pueblos, planted corn and cotton beside their irrigation canals; of the swashbuckling Conquistadores and gentle priests who brought with them the faith and culture of Spain; and, lastly, of the Americans, who leveled mountains for their copper, laced the face of the land with ribbons of concrete, dammed rivers to make the deserts bloom, and in less than a century worked changes greater than their predecessors had wrought in thousands of years.

Arizona is a land of contrasts—geologically, racially, socially, and culturally. Its mountains tower a mile or more into the air; the rivers have cut miles deep into the multicolored earth. Snow lingers on the peaks while the valleys are sweet with the fragrance of orange blossoms. Here are sere deserts and the largest undisturbed ponderosa pine forest in the world. Here are fallen forests turned to stone, and forests of trees that have survived the slow change from jungle to desert by turning their leaves to thorns. Modern jet planes fly on their regular routes, while Hopi Indian grandmothers sprinkle sacred cornmeal on the newborn infant and pray to the sun for blessings.

Arizona's settlements vary from trading posts to cities. Here are sprawling cow towns with false-fronted buildings and most of the other characteristics of Wild West fiction except lawlessness; mining camps crouched on mountain ledges; Indian pueblos whose architecture was ancient before Columbus sailed; farming villages where practically all inhabitants are pious members of one church; reservation stores where Indians exchange their blankets and jewelry for phonographs and silk headbands; tourist towns built around natural wonders such as the Grand Canyon; palatial resorts where wealthy seekers of health and recreation gather; lumber camps where the roar of the sawmill is heard day and night; ghost towns where bats and ground-squirrels flit through cobwebby ruins; and, lastly, such cities as Phoenix and Tucson, with their great air-cooled buildings, country clubs, and all the other trappings of this modern day.

Arizona owes much of its color and individuality to the Mexican-Americans who share many customs with people south of the border. Nearly every town of any size has a *Colonia Mexicana*—often a picturesque reminder of an earlier period of the State's history. The Indians afford a bright note for Arizona and are part of the charm that is Arizona's.



The "Sphinx" rests high on a hill in the Petrified Forest National Monument in Arizona, where striking formations of petrified wood are preserved.

Two years before Arizona—the Grand Canyon State—was admitted to the Union, the 1910 census listed its population as 204,000. By 1950, this total had grown to 750,000. But in the great western movement of our people in the past decade, Arizona's population by the 1960 census had increased to more than 1,300,000—a gain in 10 years of nearly 74 percent.

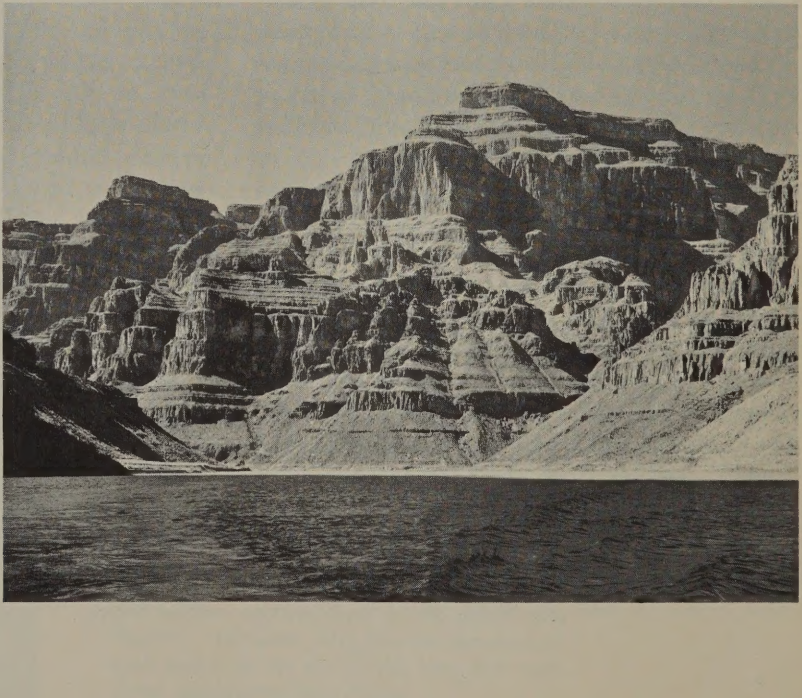
This dynamic growth remains in full swing today—based in large measure on the conservation, wise use, and development of the State's vast store of natural resources. Through the years, the Department of the Interior has played an active role in resource programs in Arizona, and it is proud of the contribution it has made to the State's growth and progress.

Manufacturing now is Arizona's biggest industry, followed by agriculture, mining, and the fast-growing tourist industry. The State ranks first in the Nation in copper production, and its mines also produce gold, silver, lead, zinc, barite, molybdenum, vanadium, tungsten, manganese, and uranium ore.

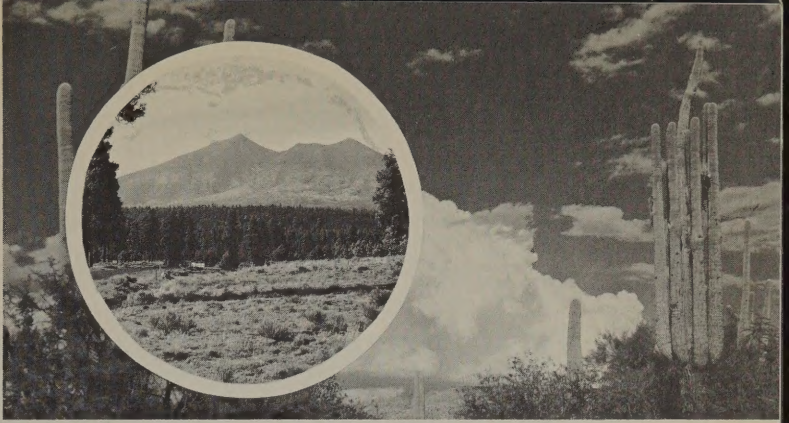
Alfalfa, in some parts, yields five to eight crops per year with the aid of irrigation. Citrus fruits, dates, barley, sorghum, cotton, wheat, cattle and sheep are also raised.

Arizona has five major colleges and universities, the principal ones being Arizona State University and the University of Arizona.

The turbulent Colorado River gives life to Arizona, providing water for home, farm, and industry. The scenic grandeur of the river makes it an important recreational resource.



Physical Characteristics of Arizona



WITH an area of 113,956 square miles, Arizona is the sixth largest State in the Union. Utah lies along the full extent of its extreme northern boundary; on the south it is bordered by Mexico, on the east by New Mexico, and on the west by Nevada and California.

The State comprises three distinctive physical areas, each with its own more or less individual climate, flora, and fauna.

The northern part of Arizona lies within the Colorado Plateau region and is distinguished by its remarkable canyons, including the Grand Canyon of the Colorado River. From the base of the plateau, there is a rapid descent to the south. The area is drained by the Colorado, Little Colorado, and Verde rivers, together with a number of smaller streams.

The mountain region of Arizona, lying between the plateau and plains sections, comprises the lower half of Mohave County, all of Yavapai, Gila, Greenlee, Graham, Cochise, and Santa Cruz Counties, the western half of Pima and Pinal Counties, and the northwestern part of Maricopa County. This region is rich in mineral resources, principally gold, silver, and copper.

The plains district, comprising about 35 percent of the State's area, lies partly in central, but mostly in southeastern Arizona. The district is heavily irrigated and contains the Gila and Salt River valleys, two of the most fertile areas in the United States.

Most important of Arizona's rivers is the Colorado, which flows through the northwestern part of the State and forms the State's western boundary for nearly all of its remaining course. With its numerous tributaries, chief of which are the Gila, Little Colorado, and Bill Williams Rivers, the Colorado drains almost the entire State.

The important determinates of climate in Arizona are altitude, interfering mountain ranges, and distances from large bodies of water. In general, rainfall is light and humidity low, making for clear air and a very dry atmosphere. This results in a wide variation between day and night temperatures; in summer the mercury may soar during the daylight hours, but night brings a refreshing coolness.

The mean monthly temperature in Phoenix ranges from a low of about 51 degrees in January to a high of about 90 degrees in July, the annual mean being about 70 degrees. But temperature variations incident to elevation are considerable throughout the State. Over the mountain plateaus, summer temperature seldom exceeds 90 degrees; but extremes ranging up to 125 degrees are recorded in lower elevations nearly every summer. In winter, night temperatures range from 32 degrees above to 25 degrees below zero over most of northern Arizona.

Total annual rainfall varies between the two extremes of 2 to 5 inches in the lower Colorado River Valley and from 25 to 30 inches in the mountains.

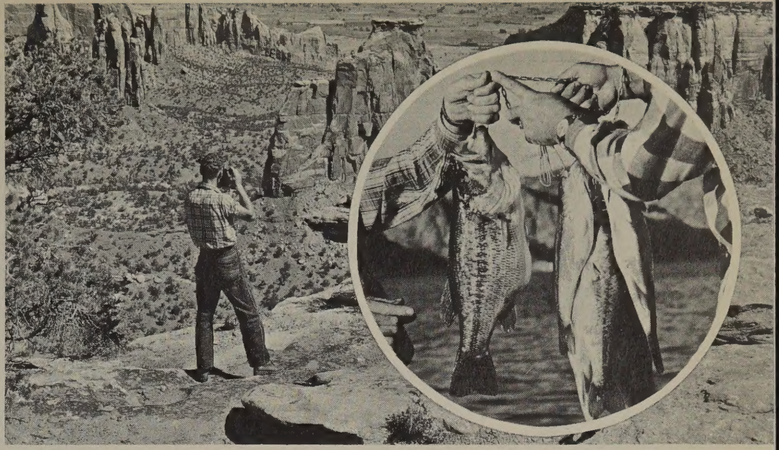
Sunshine is one of Arizona's greatest assets. The amount of possible annual sunshine enjoyed in different parts of the State ranges from 73 to 90 percent, with an average for the State as a whole of about 80 percent. Phoenix has an annual average of 235 clear days.

The popular conception of Arizona is of a barren desert country, yet the flora ranges from the subtropical to the subalpine. Strange and unusual plant types are found from mountain peak to desert floor. As the altitude varies, so does the vegetation, and seasonal conditions determine largely the abundance of flowers and the length of the blooming season. Good rains in November, December, and January bring a beautiful spring blooming, spreading colors with a lavish hand on mountains, mesas, and deserts. Miles of golden poppies and countless Mariposas of varying color carpet the foothills and the mesas; in the mountains the air is filled with the scent of pine and the fragrance of flowering shrubs; and the desert is spread with a tapestry of innumerable blossoms.

Rainbow Bridge, towering 306 feet above an intermittent stream, is a spectacular sight in Arizona's plateau region.

A lookout on a fire tower keeps watch over Arizona forest lands, a valuable natural resource in the State.

Park and Recreation Resources of Arizona



As a natural locale for sports and recreation Arizona leaves little to be desired, for its wide range of temperature and elevation and its varied topography provide activities to suit practically all tastes. In winter, for example, skiing and tobogganing may be enjoyed in the northern mountain area while—by traveling a few hours to the south—one may "drop down" to a sundrenched desert playground.

It is largely because of this lure for the hundreds of thousands of Americans seeking outdoor recreation that tourism now ranks fourth among the State's industries.

Of Arizona's approximately 72.9 million acres of land, more than 32.4 million acres or over 44 percent of the total are federally owned. A large amount of this Federal land is available for recreation purposes, and much of the State's vast recreational potential has yet to be developed. With a population density of only about 11.5 per square mile, despite Arizona's rapid recent growth, the potential represented by its huge areas of open space—ranging from colorful desert to green, forested mountains—may be clearly visualized.

The National Park System of the Department of the Interior in Arizona consists of 20 units totaling more than 4.1 million acres. Included are one National Park, 16 National Monuments, one National Memorial, and two National Recreation Areas.

Grand Canyon National Park—some 50 miles from east to west and 25 miles from north to south—contains the most spectacular part of the Colorado River's greatest canyon and is a mecca for visitors from all over the world. This park can be reached by many roads.

The slow, steady cutting of the Colorado River through eons of time produced this spectacular gorge fifty miles long and twenty-five miles wide. Its vastness swallows sound and motion, and nowhere else is so revealed the history of the earth. It is a notable experience to glance downward—and equally notable in the bottom of the canyon to cast your eyes skyward.

Grand Canyon National Monument, which joins the Park at its western boundary, contains one of the most magnificent views of the whole Colorado River canyon. At Toroweap Point there is a 3,000-foot, straight-down look at the river at the bottom of sheer rock walls.

Lake Mead National Recreation Area, located in Arizona and Nevada, consists of two vast blue lakes and the surrounding terrain of brilliantly colorful desert, lofty plateaus and narrow, deep canyons, as well as 93 miles of the Grand Canyon. Formed by Hoover Dam which was constructed by the Department of the Interior's Bureau of Reclamation, Lake Mead is one of the largest artificial lakes in the world. It is 115 miles long and has a shoreline of 550 miles. Lake Mohave, formed by Davis Dam, is narrow but 67 miles long. They can be reached by major highways, U.S. 66, 93, and 91.

Painted Rock Reservoir, under construction by the U.S. Army Corps of Engineers is scheduled for development by the Arizona Fish and Game Department through arrangements with the Department of the Army, the Department of the Interior, and the State government.

The Alamo Reservoir, another Corps project not yet under construction, is also being considered for recreational development.

The Glen Canyon region is a wild and little known part of the dwindling American wilderness—scenically spectacular canyons, towers, buttes, and cliffs carved by nature through cen-

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Sailing is among the many popular kinds of recreation offered around Lake Mead, the 115-mile artificial lake above Hoover Dam. Here the desert breezes produce full-bellied sails that make the craft streak through the blue water.

Vacationers can visit Montezuma Castle National Monument, preserved cliff dwelling in the Verde River Valley. As many as 50 persons lived in these dwellings during the peak of pueblo culture.

turies of time. The blue inland sea of Lake Powell, rising behind Glen Canyon Dam will afford easy access to this wilderness area destined to become one of the outstanding tourist areas in the Nation.

The natural and historic features of the Glen Canyon National Recreation Area in addition to the 186-mile Lake Powell—which will be stocked with 8 million rainbow trout and 2 million black bass by 1964—will also permit easy access to the spectacular Rainbow Bridge by boat and a relatively short hike.

In all, seven widely spaced areas will be developed for recreational access with facilities for fishing, swimming, boating, water skiing, and camping. Food, lodging, and other services will also be provided by concessionaires.

Glen Canyon Dam will also clear the muddy waters of the Colorado River downstream to Hoover Dam, turning this area also into a clear, shining recreational resource.

Other units of the National Park System in Arizona include:

Canyon de Chelly, north from Gallup, east from Tuba City-Keams Canyon route; Casa *Grande*, on State route 87; *Chiricahau* reached from Bisbee and Douglas; *Montezuma Castle*, may be reached from US 89A, or State routes, 69 or 79; *Coronado*, 30 miles west of Bisbee off State Route 92;

Navajo, completely surrounded by Reservation in a roadless area;

Organ Pipe Cactus, reached via U.S. route 80 and State Routes 85 and 86; *Petrified Forest National Park*, approaches are U.S. 66 and U.S. 260; *Pipe Spring*, from U.S. 89A via State route 389; *Saguaro*, 16 miles from Tucson by way of East Broadway Avenue; *Sunset Crater*, reached by U.S. 66 and 89; *Tonto*, U.S. 60–70 from Mesa to State route 88;

Tumacarori, located off U.S. 89 south of Tucson; *Tuzigoot*, reached via U.S. 89; *Walnut Canyon*, connects with U.S. 66 east of Flagstaff; Wupatki, entrance road to Sunset Crater also adjoins this park area.

Leaflets describing the features of many of the above areas can be obtained by writing Office of Information, National Park Service, Department of Interior, Washington 25, D.C.

Even a partial listing of the State's total recreational attractions is a most impressive one.

In addition to the large reservoirs in the Lake Mead and Glen Canyon recreation areas, there are eight medium-sized reservoirs: Imperial, Havasu, Roosevelt, Canyon, Apache, Saguaro, and Lyman.

The Fish and Wildlife Service of the Department of the Interior maintains seven refuges in Arizona, including six recreation developments and one nature preserve.

The 13 million acres of national land reserve administered by the Department of the Interior's Bureau of Land Management supports numbers of deer, bighorn sheep, antelope, game birds and other wildlife sought by camera fans and sportsmen. These acres provide space for highly popular trail rides, for rockhounds, campers, desert sightseers and other recreationists.

The Forest Service of the Department of Agriculture administers seven National Forests, whose 12 million acres include 167 recreational developments. It also maintains 13 wilderness areas of 716,415 acres and three nature preserves of 2,100 acres.

The National Forests are located primarily in the central portion of the State and eastward—with two, Apache and Coronado, extending into New Mexico. Arizona's National Forests contain over 2,000 miles of fishing streams and 65 lakes, drawing more than one-half million anglers annually. Winter sports, picnicking, hiking, camping and other forms of outdoor recreation are enjoyed in Arizona's National Forests by more than 5 million people annually. Hunting and fishing are permitted under State regulation.

This expanse of land has many uses producing water, timber forage, fish and wildlife—as well as offering prime outdoor recreational opportunities. Arizona's National Forests and their major attractions follow:

Apache, with headquarters in Springerville, covers 1,732,571 acres, 542,503 acres of which extend into New Mexico and contains the Blue Range Primitive Area and the Mount Baldy Primitive Area. There are 29 camp and picnic sites, and the use of small, motorless boats is permitted in Big Lake and Luna Lake.

Coconino, with headquarters at Flagstaff, encompasses 1,800,786 acres. Here are found the highest summits in Arizona, the San Francisco Peaks. Canyon plant and animal life is found in the Sycamore Canyon Primitive Area. The Arizona Snow Bowl Winter Sports Area, 28 camp and picnic sites, facilities for horseback riding, and boating are some of the recreation opportunities available.

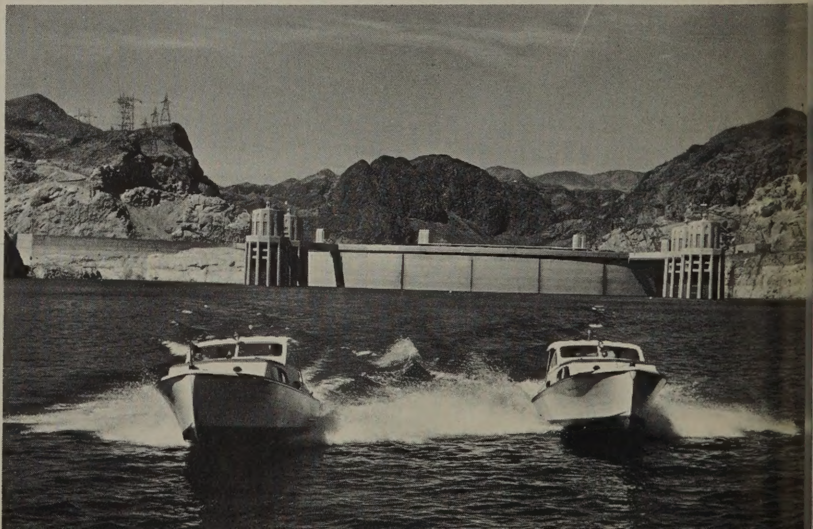
Coronado, with headquarters in Tucson, takes in 1,724,240 acres, 69,567 are within New Mexico. Here is found Mount Lemmon Snow Bowl, the southernmost winter sports area in the U.S. The forest contains the Chiricahua Wild Area and the Galiuro Wild Area of rugged knifelike mountains jutting from the Arizona plain. Within Coronado are 47 camp and picnic sites, 52 acres of bass fishing on Pena Blanca Lake and game to challenge the most rugged outdoorsmen.

Kaibab, headquartered at Williams, covers 1,718,043 acres. Part of the Sycamore Canyon Primitive Area runs into the Kaibab National Forest which also includes access routes into the Grand Canyon, Supai Indian villages in Havasu Canyon, and the Grand Canyon National Game Preserve famous for its deer herd, wild buffalo, and the Kaibab squirrel. Six camp and picnic

Tourists on mules follow trails overlooking the magnificent vari-colored vista of Grand Canyon National Park.

Among Arizona's recreational attractions are several large reservoirs which provide swimming and boating for an increasing number of visitors each year.

Boating enthusiasts can get a close look at Hoover Dam from the Lake Meade side of this pioneer Bureau of Reclamation multipurpose project.



sites are here, and several hunting camps are open during the hunting season.

Prescott, with headquarters in Prescott, covers 1,247,622 acres within which are the Sycamore Canyon Primitive Area and the Pine Mountain Primitive Area. In addition to 19 campgrounds and picnic areas, the Nation's largest ghost town within the Forest attracts many tourists.

Sitgreaves, with headquarters in Holbrook, covers 773,191 acres. Attractions include the scenic Mogollon Rim Drive and pueblo ruins. There are 4 camp and picnic areas and many privately-developed facilities, such as hotels, resorts, guest ranches, and a country club.

Tonto, headquartered at Phoenix, covers 2,892,314 acres. Within the Tonto are the Sierra Ancha Wild Area, the Mazatzal Wilderness Areas, and the Pine Mountain Frimitive Area. Replete with legends and folklore of the southwest is the Superstition Wilderness Area, in which lies hidden the Lost Dutchman gold mine. Tonto offers 30,000 acres of man-made lakes, and contains 41 camp and picnic sites.

The State Park Board of Arizona operates three State monuments and one recreation area; the State Game and Fish Department maintains four wildlife refuges, and 379 roadside rest areas are under the jurisdiction of the State Highway Department.

Private enterprise in the State provides four nature preserves, two wildlife refuges, four monuments, and numerous additional recreational accommodations and services.

Privately-Owned Recreation Facilities

Privately-owned recreation facilities are of major importance in Arizona. These vary from resident summer camps for boys and girls to fine hunting areas. The State's crop and pasture lands contribute significantly to the supply of outdoor recreation opportunities. Many operate as vacation farms, accepting tourists who live at the farm or ranch during their stay. Others lease or supply hunting opportunities, often in combination with cabin facilities. Camping, picnicking, fishing, hiking, horseback riding and guide services are provided by some. Many lease or sell scenic sites for home and camp lots.

Lists of all the privately-operated recreation opportunities in Arizona are not available from any single source. Travel bureaus and agencies, commercial organizations such as gasoline companies, motel and hotel associations, airlines and railroads, local Chambers of Commerce and outdoor clubs and organizations all can supply information on many of the privately-owned facilities. Local inquiry will reveal others. Information is available from the Arizona Development Board, 1521 W. Jefferson, Phoenix 7, Arizona.

The Navajo Tribal Parks Commission, which has been established by the Navajos, is moving ahead with plans to improve existing park areas and create new ones on the Navajo Reservation to encourage tourist travel and hunting, fishing, and swimming. Game importations, mostly turkeys and antelopes, are included in plans for increasing hunting opportunities.

Within the Indian Reservations are one park of 90,000 acres, 50 camping areas, 704 picnic grounds, and 500 cabin sites; three wilderness areas of nearly 3 million acres; and 23 other recreation developments of various sizes.

In addition to the historic sites of the Spanish and Mexican conquests, the Indian Reservations and cultures, and the early mining and pioneer sites, the following western towns are vacation attractions: Flagstaff, Williams, Springerville, Holbrook, Winslow, Prescott, Kingman, and Payson. Just west of Flagstaff, in the mountain country of the north, is Lowell Observatory; and near Winslow is the famous Meteor Crater.

It is small wonder, then, that, year by year, growing millions of Americans are drawn by the magnet of Arizona's recreational attractions—and add increasing millions to the State's economy.

As a part of its game management program, Fort Apache Indian Reservation permits bear hunting in season. This sport attracts hundreds of hunters each year.

Fish are caught year-round in Arizona, and fishing is enjoyed by more than three million visitors annually.

Fish and Wildlife Resources of Arizona

ARIZONA, long a "promised land" for hunters, is now acquiring a new status with sport fishermen. Its hunting resource is the natural result of the existence of large areas especially adapted to wild game. On the other hand the State's fishing potential lies in the artificial impoundments created for agriculture and industry and in the altered streamflows from these impoundments, such as the trout fisheries in the cold waters released from these impoundments. So also is the fishing potential of various waters on Indian Reservations being developed and being made available to the anglers.

The Grand Canyon State is presently engaged in a gigantic task of water conservation and utilization and soil conservation. The Colorado River Front and Levee project, the big Glen Canyon Dam now under construction, the Colorado River developments and other developments already completed, or in progress, or under consideration are some of the many things that have changed or are changing the face of Arizona. And with these changes come opportunities to enhance fish and wildlife values.

There are many species of big game available in season to the hunter. Black bear, mountain lion, deer, elk, and other species are found in sections of the State.

The mule deer, so called because of his long ears, is the principal big-game animal of Arizona and is found throughout the State. The largest bucks weigh up to 240 pounds dressed and carry antlers with a spread of 30 to 40 inches. The little Arizona whitetail, seldom weighing more than a hundred pounds, is more numerous but also more elusive, and is found only in rough brushy country.

Largest round-horned deer in the world is the elk, the bulls sometimes weighing as much as a thousand pounds. In the early years of unrestricted slaughter of wild animals in America, this species became extinct in Arizona. But imported stock, preserved through supervision and protection, are now to be found on the Mogollon Plateau and in the Hualpai and Bill Williams mountain areas, and limited hunting is permitted.

Two herds of wild bison or buffalo are maintained in Arizona, one in Houserock Valley, and one at Raymond Ranch east of Flagstaff. Annual hunts are alternated between the 2 areas.

The State's most predatory animal, the lion, may be hunted the year around. The great cats are usually found in the roughest and brushiest country, where deer are plentiful. Occasionally the jaguar, called *el tigre* by the Mexicans, drifts in from Sonora. Many hunters seek bear as well as deer on the Mogollon Rim. A black bear is always a fine prize, occasionally weighing as much as 600 pounds. Hunting lion and bear on horseback, with a well-trained pack of dogs, is a thrilling sport that is truly western. Jaralina, and desert big-horn and pronghorn antelope are also hunted in Arizona.

Numerous species of smaller game attract the sportsman. The wild turkey, largest of American game birds and classed as big game in Arizona, is found throughout the northern pine and oak area. Because the bird is so wary that one slight awkward move or careless rustle of brush may ruin any chance of a kill, the hunter regards the taking of a wild turkey as something of a feat. Various species of waterfowl inhabit the lakes and streams, including the green-winged and blue-winged teal, mallard, widgeon, redhead, and Canada goose. White-wing doves, quail, mourning doves and cottontail rabbits,

Pronghorn antelope—typical of those transplanted in northern Arizona "Strip" by the Bureau of Land Management and the Arizona State Game and Fish Commission. There had been no pronghorn antelope in this area for nearly 50 years.

Arizona has a great diversity of native wildlife, such as chuckawalla lizards.

Wild buffalo can be seen grazing in Houserock Valley in the north central part of Arizona, where a short hunting season is permitted.

may be hunted in season, as well as jack rabbits on which there is no closed season or bag limit.

With an increasing number of artificial lakes—impounded waters of mighty Reclamation projects generously stocked from State and Federal hatcheries—and with its many mountain streams and natural lakes, Arizona has much to offer the sports fisherman. The White Mountain district in particular lures the sportsman to try his skill in its cold waters for rainbow, and other trout, which are plentiful there. The string of beautiful lakes below Flagstaff and the big bodies of water in the Salt River irrigation system provide good fishing for bass as well as numerous other varieties of warm water fish.

A new phase of developing the fishing potential on Federal areas, especially on Indian Reservations, such as the Fort Apache and Navaho-Hopi Reservations, has been opened up by the Fish and Wildlife Service of the Department of the Interior in cooperation with Tribal Councils, the Department's Bureau of Indian Affairs, and State fish and game officials. Advice on the development, even the creation, of fishery waters where fishing opportunity has been poor or nonexistent has added tens of thousands of sport fishing days in Arizona each year.

Arizona's larger rivers, including the Colorado, Gila, Salt, and Verde, have been drastically altered by impoundments and water use so that they bear little resemblance to the original streams.

To fully realize the potential which the many artificial impoundments and altered streamflows provide, State and Federal agencies are working on development of a broad-scale program to include:

—Chemical and physical control of rough fish species in both warm and cold waters.

—Increased introduction of desirable species, including the annual stocking of trout lakes with fingerlings.

—Development of new fishing lakes.

—Acquisition and development of additional access to both the lake and river portions of present and future projects along the Colorado, Salt, and other rivers.

—Developing a solution to the problems of multiple recreational use of waters, a situation which frequently finds sport fishing reduced by competition from boat racing and water skiing activities.

—A broader fisheries research program to provide answers for specific management problems, and,

—A stepping up of vegetation control in shallow lakes.

Arizona is conducting an active fish and wildlife program. Part of it is financed by Federal aid for the restoration of fish and wildlife which provides about half a million dollars a year for acquisition of access sites, acquisition and development of waterfowl areas, construction of watering devices for big game and small game to conserve and make available the water which is in scarce supply in some areas, research on the introduction of better game species and to learn more on techniques of planting trout, aquatic weed control, and other projects to preserve and utilize fish and wildlife resources.

Arizona's future game management program will be principally concerned with the more than 42 million acres of State and Federal lands. Of lesser importance will be the hunting recreation available on Indian and private lands.

Since the future of the State's hunting resources is closely tied to public lands, it is also bound to the problems of multiple land use. One of the largest of these problems is the competition between livestock and wildlife which unfortunately has cut deeply into the numbers and vigor of the more desirable forms of vegetation. There can be little doubt that the solution of this problem is the greatest single task facing future game management in Arizona. Further abuse of the range can only lead to additional reductions, natural or artificial, in livestock and game populations.

Here again State and Federal officials are collaborating in the development of a program for the future to include these points:

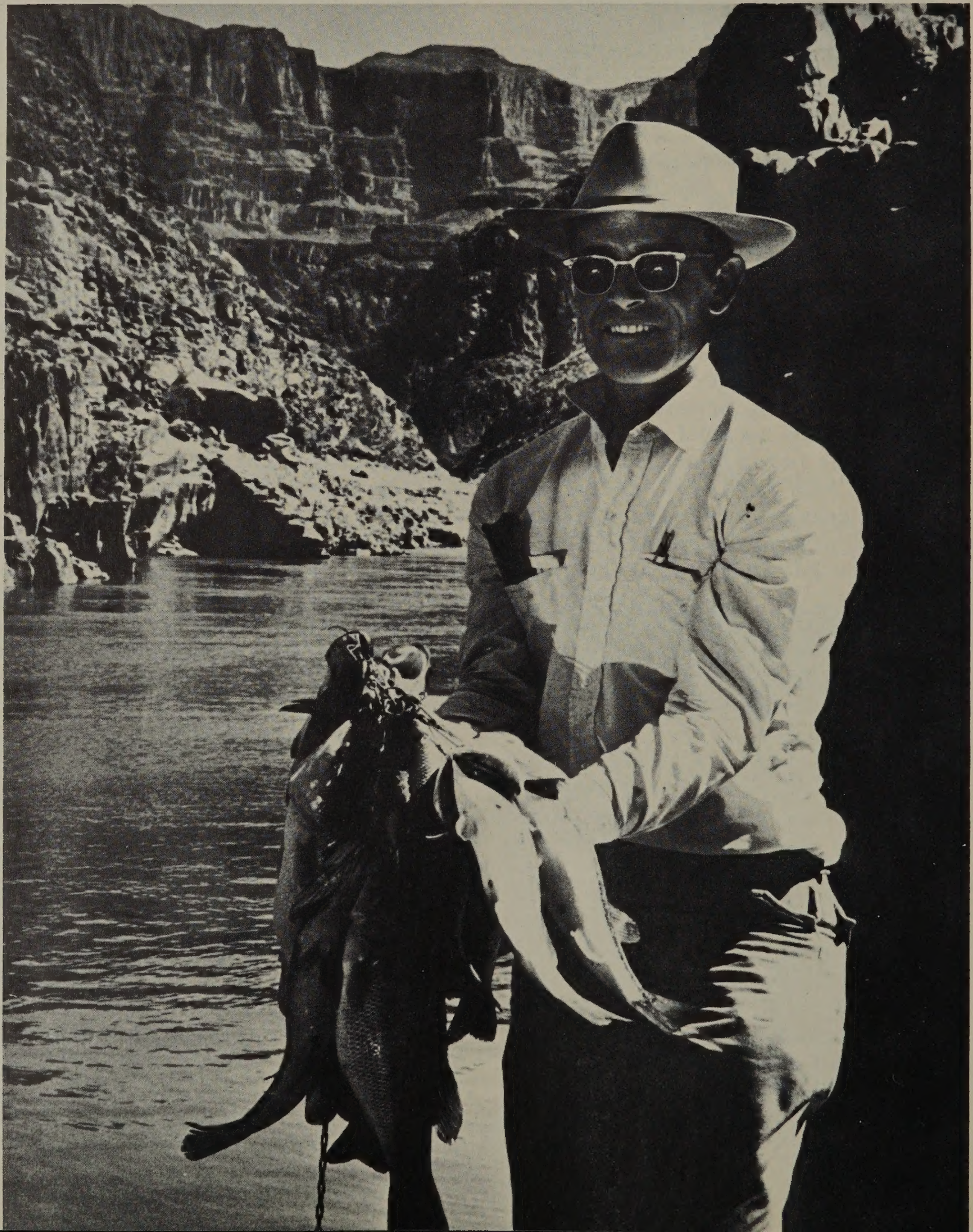
—Adjustment of combined livestock-wildlife use on public lands to realistic carrying capacities.

—Evaluation of wildlife needs for free water in desert habitat.

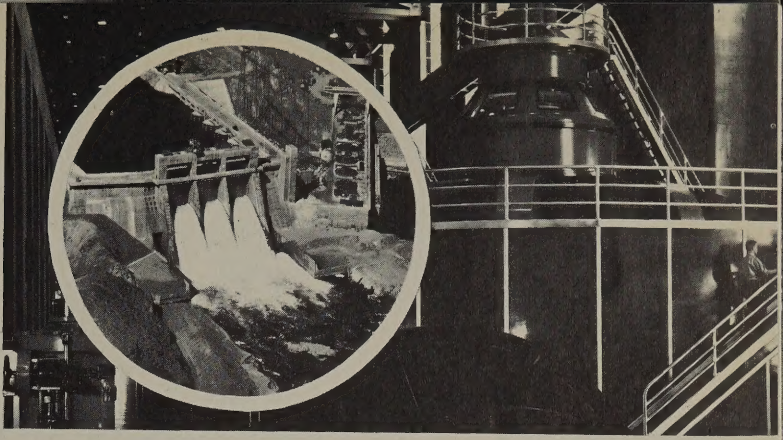
—Testing of liberalized bag limits so that hunters may be allowed maximum numbers of available surpluses.

The Fish and Wild life Service is cooperating with other Federal and State agencies to assure Arizona the opportunity of reaping the full value of its fish and wildlife resources. The Bureau of Land Management also cooperates with the State and with range users in efforts to increase forage production for wildlife and in re-establishment programs for antelope, turkey, and other species.

Good fishing is found in Bridge Canyon on the Colorado River 117 miles upstream from Hoover Dam. This string of bass and catfish was caught in the clear emerald green waters. The Colorado River between Glen Canyon Dam and Lake Mead is now clear as a result of silt control in Lake Powell, Glen Canyon's reservoir.



Water and Power Resources of Arizona



In no other State are water resources so vitally important to economic welfare as in Arizona, where high temperatures and long periods without rainfall are common, and nearly all agricultural operations are conducted on irrigated land.

Water is vital, too, to the State's municipalities, stockmen, mines, and railroads.

Vestiges of prehistoric irrigation systems along the Salt River and in other parts of the State prove that agriculture in this region was no less dependent upon irrigation in aboriginal times than it is today.

Virtually the entire State of Arizona is in the Colorado River drainage basin and almost half of the State is within the drainage area of the Gila River, which is the largest tributary of the lower Colorado River.

The principal sources of water supply for Arizona are the main stream of the Colorado River and the Gila River system. Other sources are the Little Colorado and Bill Williams Rivers and minor tributaries of the Colorado River including those of the San Juan River, a principal tributary of the Upper Colorado River.

The water supply for the extreme southeastern part of Arizona is obtained from the Whitewater Draw Basin, a tributary of the Yaqui River Basin of Mexico. The ground-water basins within the State are also sources that supply much of the development in Arizona. Pumping of ground water has averaged about 2.2 million acre-feet over the past several years and ground-water levels have been declining rapidly in most sections of the State.

Stream flows in Arizona are very erratic, fluctuating widely from year to year and month to month, and holdover storage is necessary to equate flows to provide reasonable measures of water supply for use within the State.

The waters of Arizona are conserved by both the Bureau of Reclamation and the U.S. Army Corps of Engineers through multi-purpose water conservation projects. At the writing of this booklet, the Corps of Engineers has completed four flood-control dams, and the Bureau of Reclamation has constructed 13 storage and diversion dams with associated laterals and canals. Both Agencies have additional conservation projects under way.

Power Resources

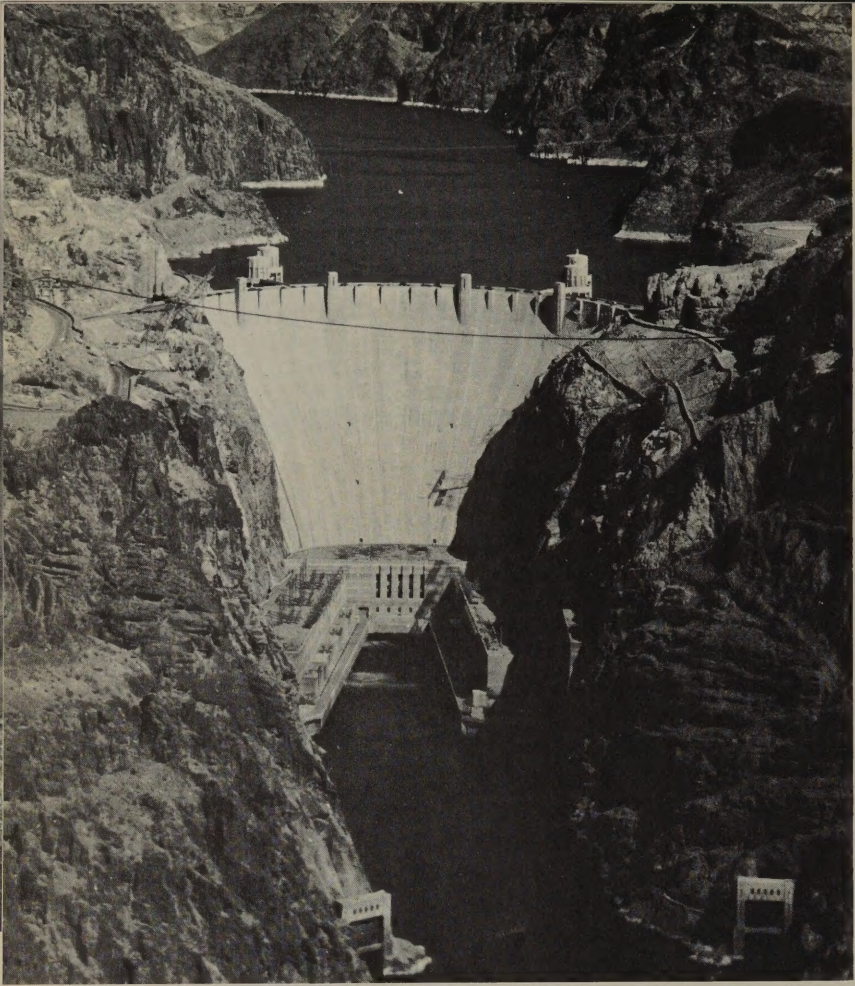
The Colorado River is the principal hydroelectric power resource for Arizona. However, there are some smaller hydroelectric plants in the State located on the Salt River, the Verde River and the Gila River.

The hydroelectric powerplants on the Salt River are operated by the Salt River Project Agricultural Improvement and Power District. Theodore Roosevelt Dam, the principal storage facility on the Salt River, together with the adjacent powerplant, was constructed by the Bureau of Reclamation of the Department of the Interior as part of the original Salt River Project system. Power was initially generated at Roosevelt Powerplant in September of 1909. The installed capacity at Roosevelt Powerplant is 19,300 kilowatts.

After the Salt River Valley Water Users' Association assumed operation and maintenance responsibility for the project on November 1, 1917, other dams and powerplants were constructed by the Association on the Salt River below Roosevelt.

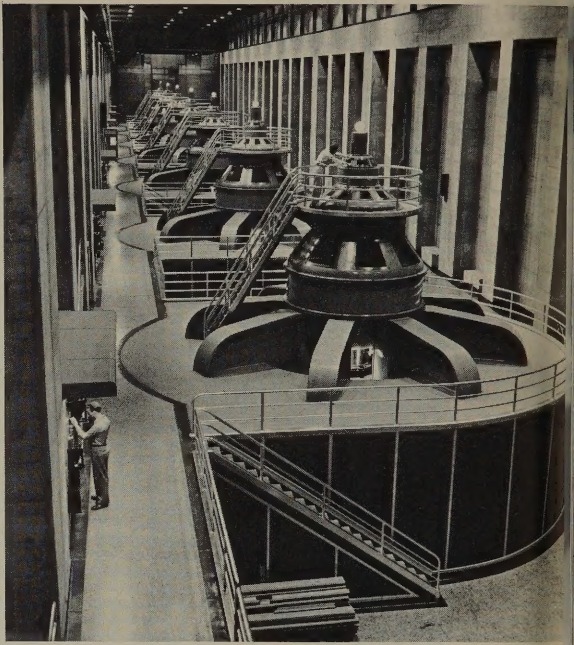
These include:

—Horse Mesa Dam and Powerplant, located approximately 15 miles downstream from Roosevelt, with an installed capacity of 30,000 kilowatts.



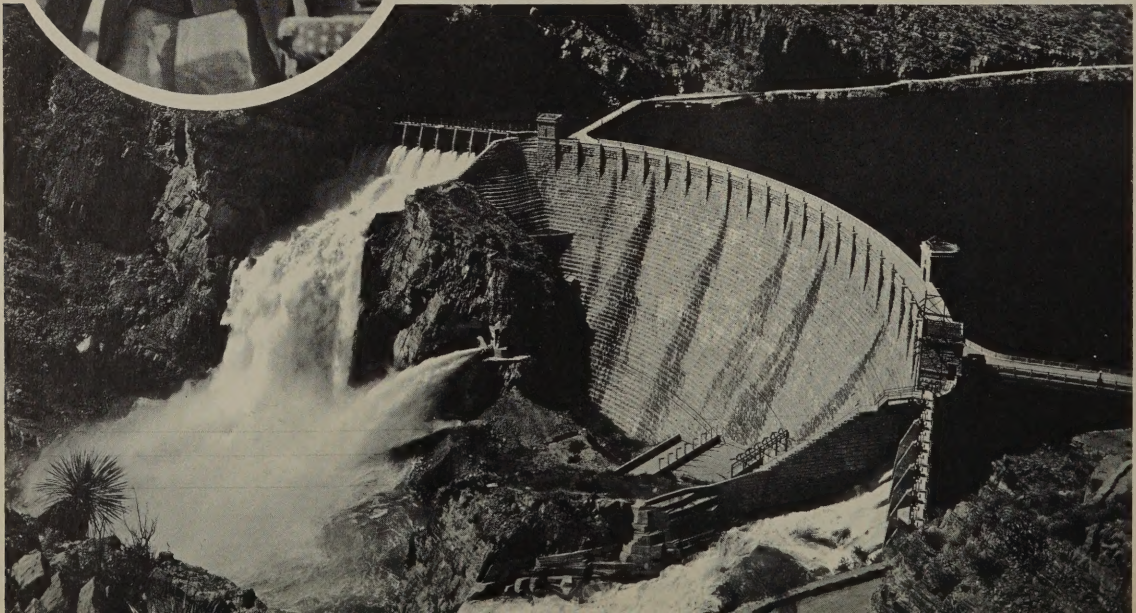
Hoover Dam, half in Arizona and half in Nevada, provided the first Colorado River control and regulation to assure agricultural and industrial development and growth in the Southwest.

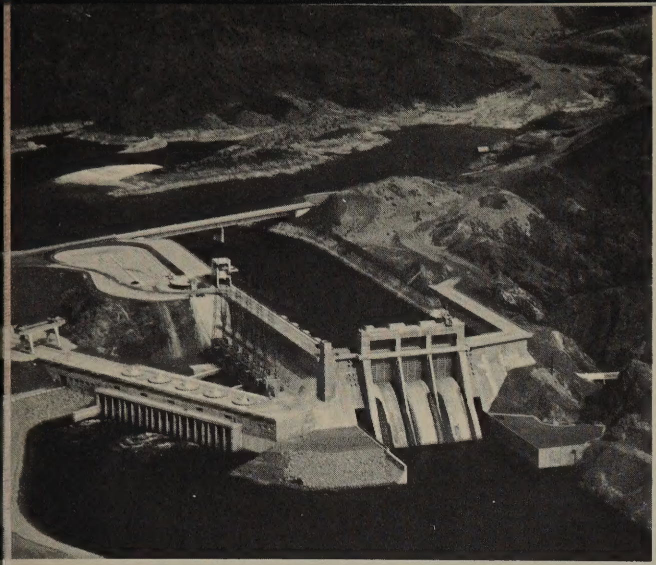
These powerful hydroelectric generating units of the Hoover Dam Powerplant annually produce billions of kilowatt hours of energy for farms, homes, and factories.



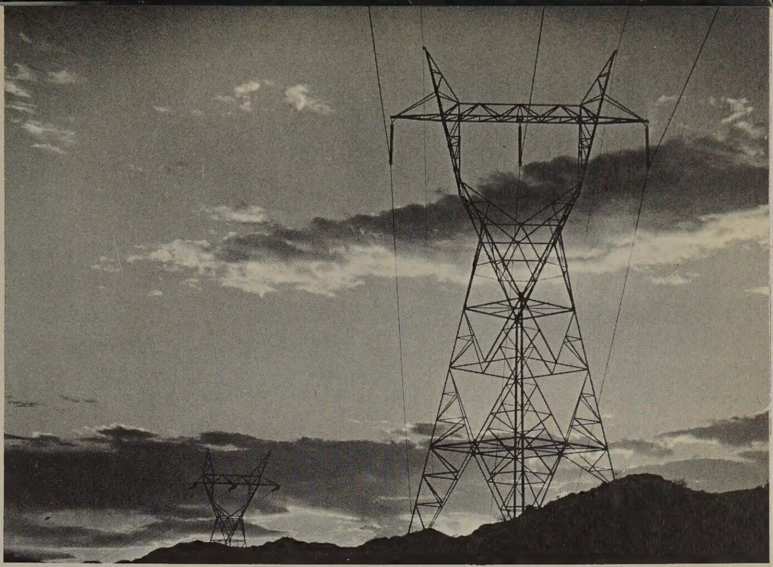
On March 18, 1911, Theodore Roosevelt dedicated Roosevelt Dam on the Salt River, the earliest Reclamation multipurpose project and the "Hoover Dam" of its day.

Theodore Roosevelt Dam, an early predecessor of today's Reclamation dams, still provides flood control, water storage for irrigation and industrial uses, hydroelectric power generation, recreation, and fish and wildlife preservation.





Looking up the Colorado River toward Davis Dam, another of the man-made structures erected to put the river's water to beneficial use.



Transmission lines carry power from Arizona's dams to load centers for fullest utilization of the State's power resources.

—Mormon Flat Dam and Powerplant, approximately 8 miles downstream from Horse Mesa, with an installed capacity of 7,000 kilowatts.

—Stewart Mountain Dam and Powerplant, approximately 10 miles downstream from Mormon Flat, with an installed capacity of 10,400 kilowatts.

Two small hydroelectric powerplants on the Verde River with a combined capacity of 7,000 kilowatts are owned and operated by the Arizona Public Service Co. The Bureau of Indian Affairs of the Department of the Interior has constructed and is operating a 10,000 kilowatt hydroelectric powerplant at Coolidge Dam on the Gila River.

Three major power developments have been constructed on the Colorado River by the Bureau of Reclamation. A portion of the output of these powerplants is utilized for serving loads in Arizona.

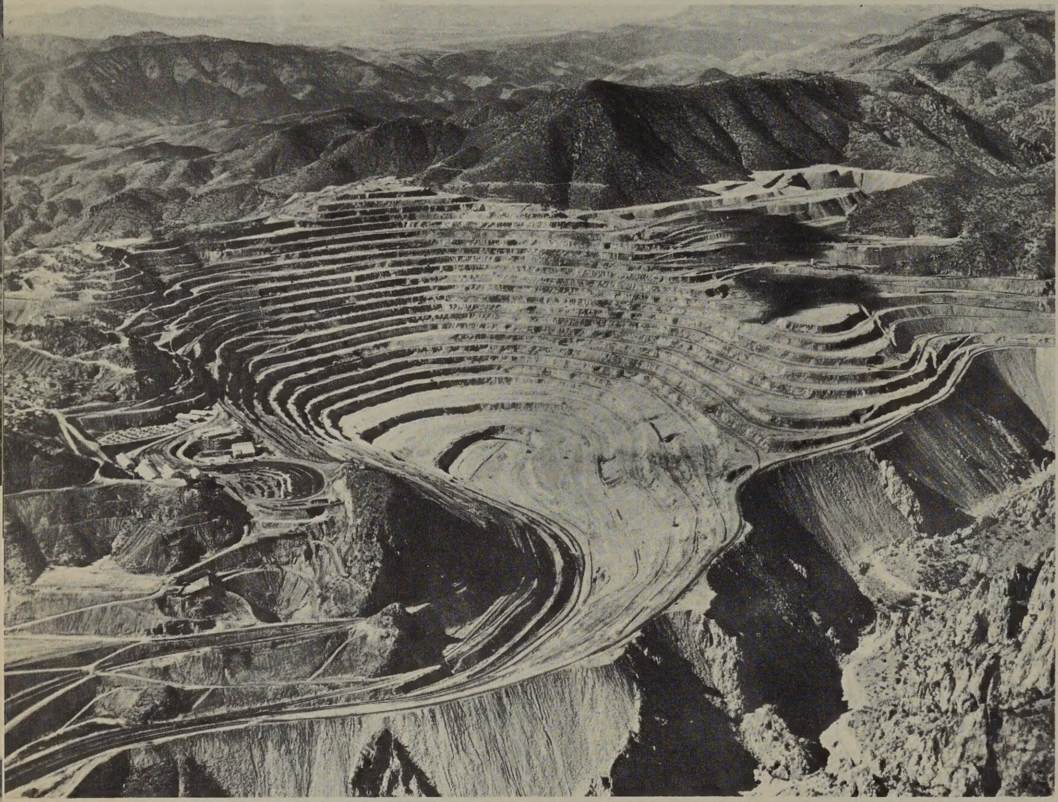
The largest of the existing powerplants is Hoover with an installed capacity of 1,344,800 kilowatts. Arizona utilizes two generators at Hoover Powerplant which have a combined capacity of 165,000 kilowatts.

In a recent year, the total energy sales from the Hoover Powerplant were more than 3.6 billion kilowatt hours. Of this total, nearly 626 million kilowatt hours were transmitted to electrical loads in the State of Arizona. The remainder was utilized in southern Nevada and southern California.

Davis Dam and Powerplant, located approximately 67 miles downstream from Hoover, and Parker Dam and Powerplant, approximately 115 miles downstream from Hoover Dam, are the other two major power installations on the Colorado River. These plants constitute the sources of electrical power and energy of the Parker-Davis Project. The installed capacity at Davis Powerplant is 225,000 kilowatts and at Parker 120,000 kilowatts. Electrical power from these two powerplants is also utilized in Arizona, southern Nevada and southern California. The total sales of Parker-Davis Project power and energy for Fiscal Year 1961 were somewhat more than 1.2 billion kilowatt hours. Of this amount, nearly 797 million kilowatt hours were utilized for serving electrical loads in the State of Arizona.

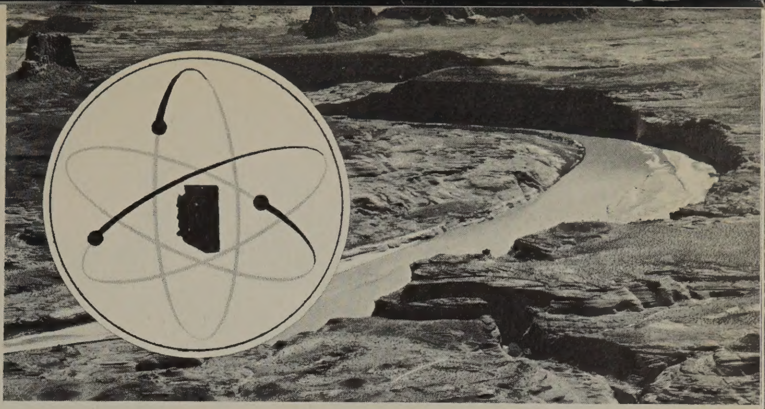
A third dam, Glen Canyon, is creating 186-mile Lake Powell on the Colorado, beginning at Page, Arizona and backing into Utah. The dam's 900,000 kilowatts of power will be essential in helping repay for Upper Colorado River Basin resource development programs. Lake Powell will be second only to Lake Mead as the Nation's largest man-made lake.

The Alamo Reservoir, a Corps of Engineers project not yet under construction, offers a potentiality for future power generation. Although power is not presently an authorized project function, penstocks have been built into the dam which will make possible the generation of power at some future time if desired.



Arizona leads the Nation in copper production by supplying half the total annual output. The red metal ore is extracted from world-famous open pit and underground mines such as the great Morenci open-pit mine in Greenlee County.

Mineral Resources of Arizona



ARIZONA produces a score of important minerals, but copper dwarfs all others in both volume and value. The State leads the Nation by supplying half the total annual output of the red metal. Copper shipped from Arizona's smelters in 1960 was worth more than $345 million and represented more than four-fifths of the value of the State's entire mineral production of $415 million.

Copper is mined in all but two of Arizona's 14 counties and in six counties it is the principal mineral product.

The metal comes from mining districts with such colorful names as "Old Hat", "Silver Bell", "Copper Mountain", "Eureka", and "Pioneer". It is extracted from world famous open pit and underground mines such as Morenci, San Manuel, New Cornelia, Lavender Pit-Copper Queen, and Ray. These five operations—the State's largest—yield nearly 70 percent of Arizona's copper. The quantity of metal obtained annually from these and other mines ranges from more than 100,000 tons—at the gigantic Morenci open pit—to a few score tons at various small lode mines.

Now producing more than half a million tons of metal a year, the copper industry is still growing. Large new mines are in production, or soon will be, in several counties, and exploration for additional ore deposits is continuing. Meanwhile, a number of older mining operations are being expanded.

As copper output rises, that of gold, silver, and molybdenum also increases because these three metals are obtained as copper byproducts.

Other minerals important to Arizona's economy are:

Uranium

The State has more than 60 uranium mines, centered principally in Apache, Coconino, and Navajo Counties. Some of the ores now mined also contain vanadium, which is being recovered at a profit.

Sand and Gravel

These building materials are second in dollar value among the mineral products of the State. They are produced in every county (except Greenlee) to meet increased demands for road building and other construction, including Glen Canyon Dam.

Iron

Iron-bearing mineral deposits of the State are beginning to attract industrial interest. Magnetite from a deposit 40 miles north of Tucson soon will become the raw material for a pig-iron plant now rising near Coolidge, Arizona. Substantial reserves of iron ore have been indicated by exploration of the Fort Apache Indian Reservation. However, Arizona's iron output thus far has been limited to sponge iron obtained as a byproduct of copper operations.

Zinc

Zinc mines are scattered throughout the State. However, most of Arizona's zinc comes from Yavapai County. Five mines account for 99 percent of the production.

Asbestos

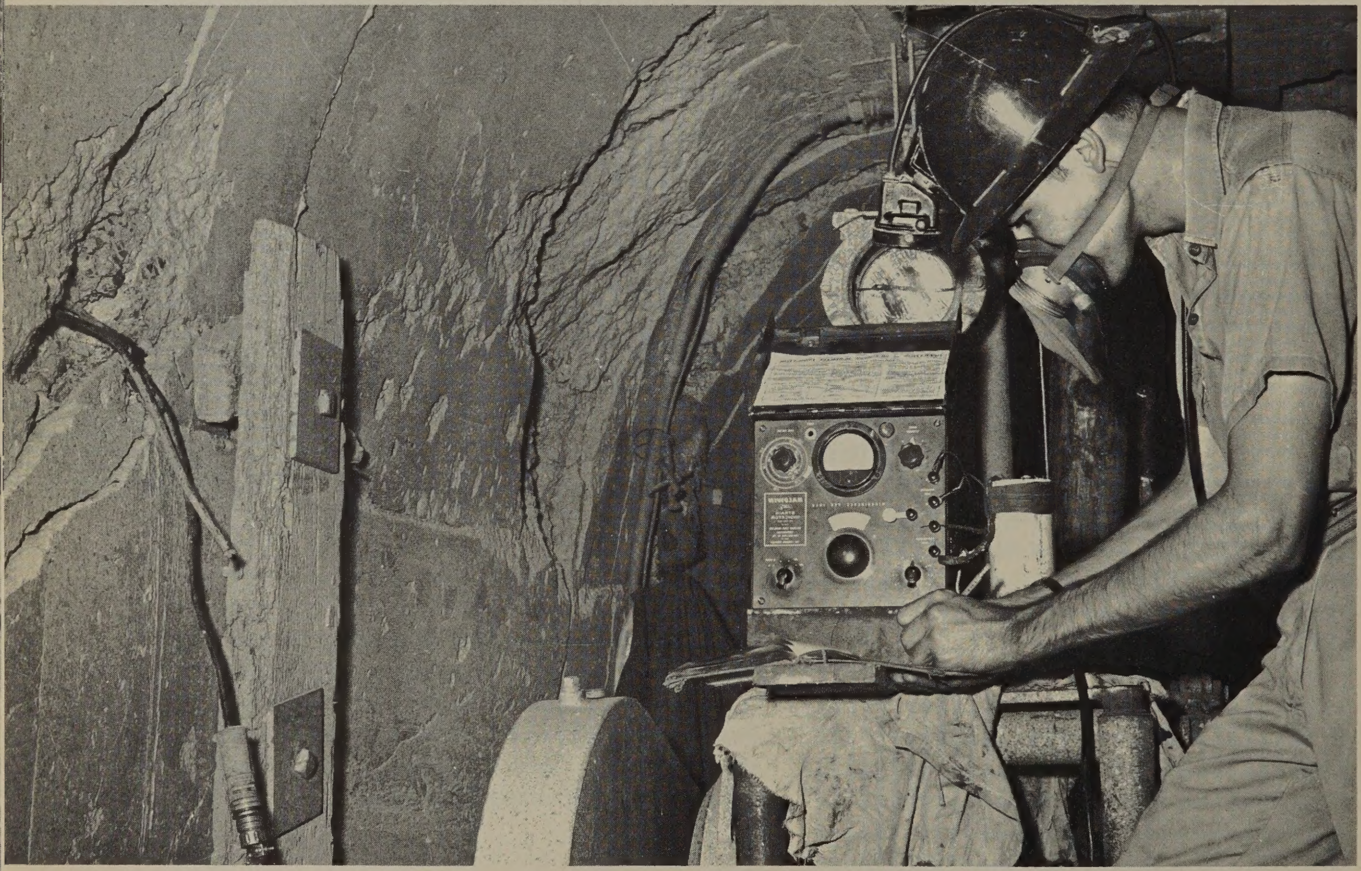
Asbestos mines are concentrated near Globe, in Gila County. Shipments of this mineral fiber have declined recently, but a new asbestos mill has been built east of Globe.

Cement

Rapid expansion of this industry, which registered a 61 percent increase in sales in a single recent year, is considered of major importance to Arizona's industrial growth.

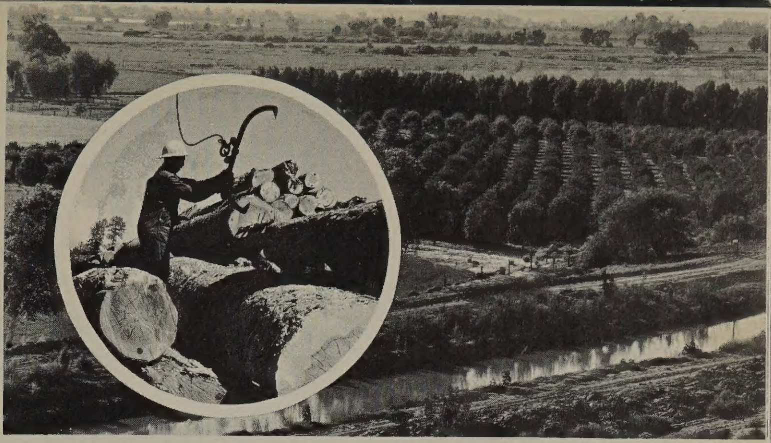
Steady, and, in some instances, remarkable production gains have been shown by the following commodities, which Arizona produces in smaller quantities:

- Clays
- Petroleum
- Gem stones
- Gypsum
- Lime
- Mercury
- Mica
- Perlite
- Pumice
- Pyrites
- Stone
- Vermiculite



A Bureau of Mines engineer checks information obtained by an electrical indicator used for field studies in rock movement. Field studies supplement theoretical, mathematical, and experimental work in Bureau research centers. Such studies help increased recovery of Arizona's mineral resources.

Land Resources of Arizona



WHEN water is added to rich soil under the Arizona sun, the results are astonishing. It is irrigation that makes possible the bounteous yields of cotton, alfalfa, small grains, sorghums, melons, lettuce, dates and citrus fruits for which the State is noted. "Manmade oases" they are called—the fertile farm districts known as Gila Valley, Salt River Valley, Casa Grande Valley, and Yuma Valley, and the smaller sections where persistence, ingenuity, and industry have made the desert bloom. Their total acreage is by no means inconsiderable, and their per-acre yield, both in quantity and value, is among the highest in the Nation.

The irrigation farmer almost never has a crop failure. Storage and wells have almost entirely removed the hazards to which pioneer agriculture was subjected. When unregulated streams were the only source of irrigation water, freshets often washed out the crude brush dams, and fields parched while floods raced away to the sea. By the time the dams could be repaired the river or creek might have shrunk to a trickle. Except in Mormon communities held together by religious ties, the result was a more than ordinarily transient agricultural population with discouraged settlers constantly "pulling up stakes" and drifting on to regions where they hoped conditions would be less difficult and uncertain.

Now the floods that were once a menace are impounded in immense reservoirs or lakes and permanent concrete diversion dams have been constructed.

In the Arizona climate, assured water means assured production. This certainty has given the State a stable agriculture, and has made a tremendous difference in the attitude of its farmers. No longer subject to the vagaries of floods and rainfall, they are contented permanent citizens instead of being (as was all too often the case in earlier times) temporary dwellers whose main ambition was to get away.

Forest Resources

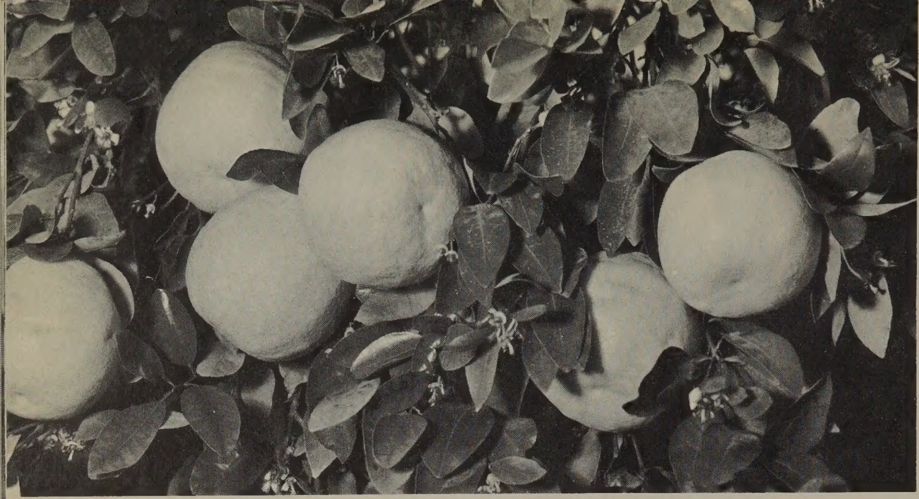
The forests of Arizona are a valuable natural asset, providing a source of lumber, protection for water resources, a home for wildlife, and areas for recreation.

Forest lands are found at altitudes of 5,000 to 11,500 feet. The mountain region contains the largest undisturbed area of Ponderosa Jeffrey pine timber in the United States. Seven National Forests, of the Forest Service of the Department of Agriculture, with a combined area of about 12 million acres, contain nearly 75 percent of the timber within the State.

The National Forests of Arizona produce about 204 million board feet of timber annually—and, of course, yield many other benefits in terms of forage, fish and wildlife, watershed protection, and outdoor recreational opportunities. Under this principle of multiple use, the Nation reaps continuing benefits from these lands.

The Forests encompass much of the State's valuable watershed areas in the high mountain regions of Arizona. The State government received 25 percent of the money collected from timber sales, grazing permits, and other use fees—funds which are earmarked for public roads and schools in counties located in Forest Service land.

Three Indian reservations in Arizona—Fort Apache, San Carlos, Apache, and Navajo—have commercially important forest resources. The volume of standing timber on these lands amounts to nearly six billion board feet. This includes about four billion board feet on the Fort Apache Reservation, 438 million on the San Carlos, and 1.497 billion on the Arizona



Yuma Mesa grapefurit, noted for its beauty as well as its taste, is grown on land irrigated with water from the Colorado River.

CALIFORNIA FRUIT EXCHANGE
RED MALAGA
DESERT SUN

The packaging of wholesome food products for the tables of the Nation provides important employment opportunities in Arizona.

Arizona's sun, climate, and water make it a major agricultural state, producing many specialty high-value crops, such as dates.

Arizona is also a producer of onion seeds—another example of the diversified use of the fertile land of this area.

portion of the Navajo Reservation. The total volume on the Navajo Reservation is approximately 2.685 billion board feet.

About 1½million acres of woodlands, composed mainly of pinion pine and juniper, and some 7,700 acres of forest lands are located on the Bureau of Land Management lands in Arizona. Of the forest lands, about 4,200 acres have present or future commercial value. Isolated stands in the high desert mountains have high scenic value and are retained in public ownership to satisfy the ever-increasing demand for picnic and camp sites.

Land area of forest resources in Arizona includes:

	Acres
Commercial forest land	3, 180, 000
Noncommercial, productive	223, 000
Noncommercial, unproductive	15, 809, 000
Total	19, 212, 000

Commercial forest land area in Arizona by stand-size class:

	Acres
Old-growth sawtimber stands	1, 787, 000
Young-growth sawtimber stands	1, 068, 000
Pole-timber stands	200, 000
Seedling, sapling stands	60, 000
Nonstocked, other areas	65, 000
Total	3, 180, 000

Commercial forest land in Arizona by ownership class:

	Acres
Federal ownership	3, 021, 000
State ownership	34, 000
County, municipal ownership	None
Private ownership	125, 000
Total	3, 180, 000

Net volume of live sawtimber on commercial forest land in Arizona by species group:

Softwoods:	*Board-feet*
Douglas fir	1, 449, 000, 000
Ponderosa/Jeffrey pine	17, 534, 000, 000
True firs	454, 000, 000
Spruce	181, 000, 000
Other, miscellaneous	199, 000, 000
Hardwoods:	
Cottonwood, aspen	171, 000, 000
Total	19, 988, 000, 000

Net volume of growing stock on commercial forest land in Arizona by species group:

Softwoods:	*Cubic feet*
Douglas fir	335, 000, 000
Ponderosa/Jeffrey pine	3, 100, 000, 000
True firs	110, 000, 000
Englemann, other spruces	45, 000, 000
Other, miscellaneous	34, 000, 000
Hardwoods:	
Cottonwood, aspen	76, 000, 000
Total	3, 700, 000, 000

Range Resources

The rangelands of Arizona are primarily breeding ranges where the cows live and raise their calves. The increase—baby-beef calves or yearlings—is driven or shipped to the farms of the Salt River, Casa Grande, and Yuma Valleys, to be fed out for market.

The sheep industry is also dependent upon the rangelands. Many Indians own small flocks of sheep, and the Navajo still own about half the sheep in Arizona. The sheep of non-Indian owners have always been run in large units. And there is a marked tendency toward consolidation of flocks under corporate ownership.

Public grazing lands for cattle and sheep are administered by the Bureau of Land Management and Bureau of Indian Affairs of the Department of the Interior and the Department of Agriculture's Forest Service.

Private, State, and Indian lands:	*Acres*
Open permanent pasture and range	27, 011, 000
Woodland pasture and range	7, 889, 000
Federal rangelands:	
Grasslands, woodlands, etc	23, 223, 000
Total	58,123,000

Cattle population: About 971,000.

Installations of Federal Natural Resource Agencies in Arizona

U.S. Army Corps of Engineers

Project Engineer Offices—Phoenix, Tucson, and Yuma

Forest Service, Department of Agriculture

Research Laboratory, Flaggstaff
Wildlife, Range, and Water Station, Tempe
Range Research Center, Tuscon

Fish and Wildlife Service

Williams Creek National Fish Hatchery, McNary
National Wildlife Refuges
  Havasu Lake
  Kofa Game Range
Management and Enforcement District, Phoenix
Predator and Rodent Control District, Phoenix
Fishery Management Stations—Parker and Springerville
Cooperative Wildlife Research Unit, Tucson

Geological Survey

District Geologist, Tucson
District Chemist, Tucson
Colorado River Basin Study Group, Yuma
Ground Water Geologist, Phoenix
Surface Water Engineers—Flaggstaff, Phoenix, Safford, and Yuma

Bureau of Indian Affairs

Area Office, Phoenix
Superintendent, Navajo Agency, Window Rock
Superintendent, Colorado River Agency, Parker
Superintendent, Fort Apache Agency, White River
Superintendent, Hopi Agency, Keams Canyon
Superintendent, Papago Agency, Sells
Superintendent, Pima Agency, Scotsdale
Superintendent, San Carlos Agency, San Carlos

Bureau of Mines

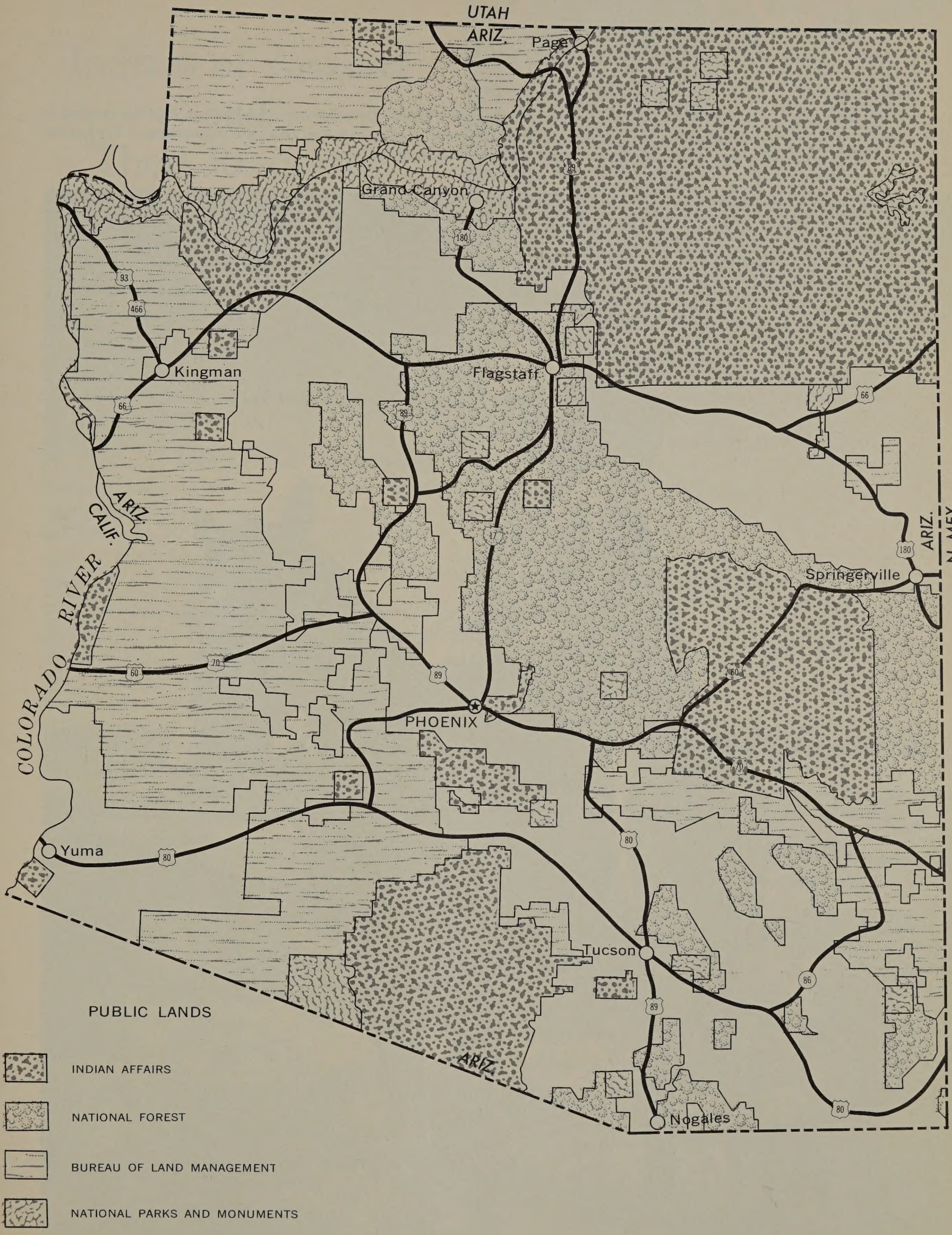
Health and Safety Office, Phoenix
Division of Mineral Resources, Tucson
Mining Research Group, Tucson
Metallurgy Research Laboratory, Tucson

National Park Service

Southwestern Archeological Center, Globe
Western Training Center, Grand Canyon National Park

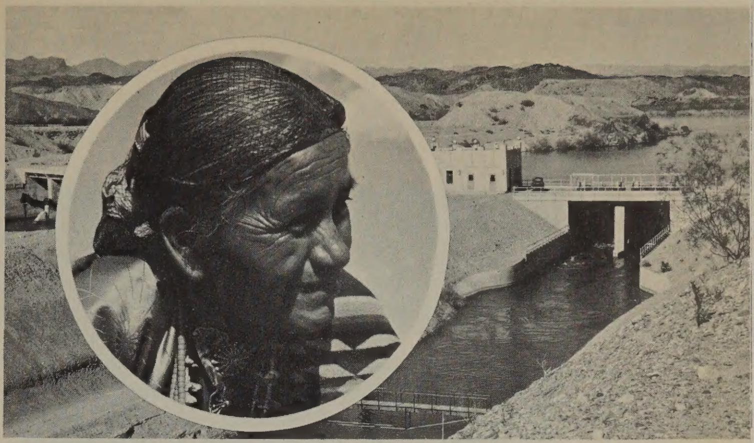
Bureau of Reclamation

Parker-Davis Project Office, Phoenix
Davis Dam Field Division, Kingman
Phoenix Land Development Office, Phoenix
Lower Colorado Land Use Office, Yuma
Yuma Projects Office
Imperial Dam Field Division, Yuma
Glen Canyon Unit Office, Page


UTAH
ARIZ.
Page
89
Grand Canyon
180
93
466
Kingman
Flagstaff
66
89
66
ARIZ.
CALIF.
COLORADO RIVER
17
ARIZ.
N. MEX.
180
Springerville
60
70
89
PHOENIX
60
70
Yuma
80
80
Tucson
89
86
80
Nogales
ARIZ.
PUBLIC LANDS
INDIAN AFFAIRS
NATIONAL FOREST
BUREAU OF LAND MANAGEMENT
NATIONAL PARKS AND MONUMENTS

Arizona's population boasts of more Indians than any other State. Development of mineral-rich land has resulted in new income for Indians, much of which has been reinvested to enhance Indian economic opportunities. The Federal government has concurrently improved health and educational facilities.

Indians of Arizona and Their Resources



ARIZONA is by far the most "Indian" of our States. It has more Indians living in it than any other—83,387 out of a nationwide total of 523,591, according to the 1960 census. It has more than half of all the Indian lands remaining in tribal ownership, approximately 21 million acres as against 41 million in the Nation as a whole. Many of its Indians, like the Hopi, live almost as their ancestors did when the Spanish Conquistadores first penetrated their desert villages four centuries ago. Others act and dress like Indians only on ceremonial occasions or when tourists or motion picture producers persuade them to.

Not all the Indian tribes in Arizona have always lived there. According to the archeologists and anthropologists, the Pima and Papago who live in the southern part of the State have dwelled there for many centuries, possibly 10,000 years or longer. So probably have the Yuman groups who live near the California and Nevada borders. So also the Hopi, whose villages on the three mesas in northeastern Arizona seem to have been there forever. But the Navajo, who now constitute Arizona's and the Nation's largest tribe, and the Apaches, who long bore the reputation of being North America's most warlike tribe, are relative newcomers. The Navajo, of whom about 41,000 now live in Arizona, are believed to have migrated southward from British Columbia or Alaska nine or ten centuries ago. Coronado first encountered the Apaches in Texas in 1540, and they are not believed to have spread into Arizona until about that time.

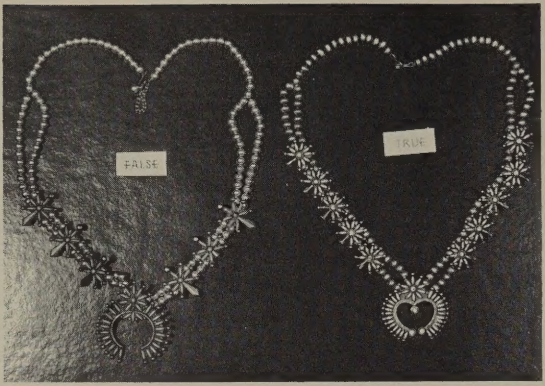
Lands

Indian lands in Arizona comprise about one-fourth of the State's total area. The largest reservation, the Navajo, which lies in New Mexico, Utah, and Arizona, includes within the State of Arizona approximately 10.7 million acres of tribal land and 80,000 acres owned by individual members of the tribe. Nineteen other reservations range in area from 2.8 million acres down to 500 acres. These lands are held in trust by the Bureau of Indian Affairs, Department of the Interior, for the Indian tribes and individual Indian owners. The acreage is expected to remain at approximately this level although some minor variations may occur as the result of transactions affecting the 260,000 acres of trust land owned by individual Indians.

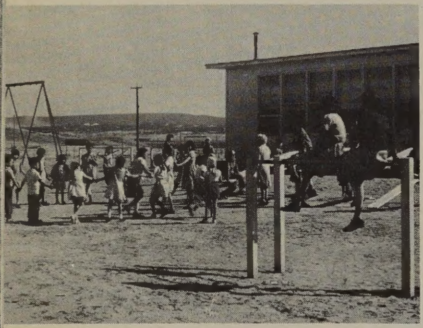
Minerals

Mineral development on Indian lands has been of fairly recent origin. Although there have been no comprehensive mineral surveys on Indian lands undertaken by State or Federal agencies, it has been the policy to encourage mineral prospecting, exploration, and development by competent private mining interests.

The principal mineral resources known to exist on Indian lands in Arizona are oil and gas, coal, iron, copper, uranium, and sand and gravel. Other minerals include asbestos, manganese, gold, silver, gem stones, and helium.



This "true and false" exhibit of Navajo silver work depicts, on the right, the delicacy of genuine Navajo silversmithing and on the left, the shoddiness of machine-made imitations. Note irregularities of the medallions on the machine-made necklace and the extension chain, which is not a feature of Indian-made necklaces.



Increasing numbers of Arizona's Indian children are attending public schools with their non-Indian neighbors. The Bureau of Indian Affairs operates its own school system like this one on the Navajo Reservation where public schools have not yet been established.

Santa Claus pays a visit to Navajo children and their mothers. Both the visitor and the hosts are dressed in traditional garb.

Oil and gas deposits were discovered in the Aneth Extension of the Navajo Reservation in Utah following World War II and, subsequently, exploration and leasing have expanded into Navajo lands in northeastern Arizona.

Large coal deposits, believed to contain several hundred million tons, are located in the Navajo area of northeastern Arizona. The coal is a sub-bituminous variety which will, in all likelihood, need to be consumed by thermal power plants or gasification plants located near the production area. The coal seams lie fairly close to the surface, outcropping in many places, and any mining operations will most likely be stripping operations.

A deposit of low-grade iron has been known to exist in the northeast corner of the Fort Apache Reservation for a number of years. It was the subject of a study by the Geological Survey of the Department of the Interior about 30 years ago and another by the Department's Bureau of Mines in the 1940's. Drilling is now under way under an approved prospecting permit with option to lease granted in 1960.

Production of copper concentrates has started on non-Indian lands adjacent to the San Xavier Reservation in the southern part of the State and lease options have been granted on Indian land in the area.

In October 1959, officials of the San Carlos Apache Tribe, with the approval of the Department of the Interior as trustee, granted to a private company an exclusive mineral prospecting permit covering their entire reservation of more than 1.8 million acres. A similar permit in favor of the same firm was recently negotiated and approved covering all but a small portion of the 2.8 million acre Papago Reservation. This remaining part of the Papago Reservation, which is a known mineral region, is covered by prospecting permits with lease option. Here again, the mineral that is most indicated by known geological data is copper.

Sand and gravel deposits in the Salt River and Gila River Valleys, near Phoenix, are enormous. Much of the valley areas are contained within the Salt River, Gila River, Maricopa Ak Chin, and Fort McDowell Reservations.

Following World War II, there was an intensive search for uranium in the southwestern United States. Several hundred uranium prospecting permits were issued on the Navajo Reservation. Most of these were in favor of individual Navajo Indians. The permits resulted in about 20 leases, which are in effect at this time. The Atomic Energy Commission, which is the sole purchaser of uranium concentrates, curtailed its purchasing program in 1958, and prospecting and leasing for uranium has been comparatively inactive since that time.

Asbestos and manganese operations on the Fort Apache and San Carlos Reservations have not proved to be successful except during periods of government price support or stockpiling programs. Considerable interest has been shown in helium production in connection with oil and gas operations on the Navajo Reservation. Public Law 86–777, which became effective March 1, 1961, authorized the Federal Government to purchase crude helium from plants maintained by private industry. Prior to that time, the production and distribution of helium was a government monoply.

Timber

An inventory of the timber on the San Carlos Reservation was completed in 1955 by a firm of forestry consultants under a contract with the San Carlos tribe. A management plan and cutting schedule based on the data obtained by this inventory have been prepared. An annual cut of about seven million feet is contemplated under this plan.

The Fort Apache Tribe has for some time operated a planing mill producing about nine million board feet annually as a tribal enterprise. Logging and sawmilling of the tribal timber to supply this planing mill have been contract operations. On the basis of a recent inventory of the tribal timber resource, Federal Government forecasters now believe that an annual cut of about 20 million board feet can be made by a sawmill operated as a tribal enterprise. The tribe has decided to enter into this venture and has secured loans from private as well as Federal Government sources. Construction of the mill was scheduled to start at approximately the time of this writing.

The Navajo Sawmill, a tribal enterprise, has for some years been cutting approximately 17 million board feet of timber per year. This sawmill provides considerable employment for members of the Navajo Tribe.

Following recent inventories, which indicate that as much as 53 million board feet can be safely cut annually for some years to come, the tribal council reached a decision based on feasibility studies to construct and operate a new sawmill with a capacity of about 35 million board feet a year.

The new mill, now completed, is of the most modern design. It is expected to cost about $8.5 million and will include a department for planing and kiln drying lumber.

For a period of 8 to 10 years the two sawmills—with a combined capacity of more than 50 million board feet per year—will both be operated until much of the overmature timber has been removed. The combined operation will be known as the Navajo Forest Products Industries.

A management board has been selected by the tribal council to act as a board of directors for the tribal enterprise. A general manager with wide experience in the lumber industry has been selected by the management board. The board is made up of nine members with four Navajos representing the tribe. The remaining five members were selected for their familiarity with the business world and the lumber industry.

A program has been started at the exisiting mill to train the large numbers of Navajos who will be employed in the expanded enterprise. It will be a major job source for Navajo workers.

Indian Irrigation

Within the Indian reservations of Arizona, there are 64 irrigation projects or systems ranging in size from approximately 100,000 acres to small subsistence garden tracts of just a few acres.

Largest of the reclamation projects to benefit the Indians is the Navajo Indian Irrigation Project, which President Kennedy approved in 1962 in signing enabling legislation passed by Congress. The project, which ultimately will serve 110,630 acres of land in and adjacent to the Navajo Reservation, will receive its water from a reservoir created by the Navajo Dam on the San Juan River in New Mexico. Although construction of the project is expected to extend over a 14-year period, water will reach the first farms in a few years.

Two of the larger existing reclamation projects operate and maintain power systems and obtain their power either from generating plants constructed by the Bureau of Indian Affairs or through power contracts with other suppliers. This power is primarily used for the operation of irrigation pumps and domestic purposes on or bordering the reservations.

This picture, taken over 60 years ago, shows a Niman-Kachina (post-harvest) dance on the Hopi Indian Reservation in north-central Arizona. In recent years Arizona's Indians have modernized their mode of life greatly, but still retain many of the old customs and tribal ceremonies.

Studies are now under way on all Indian irrigation projects and systems of the State looking toward three main objectives: (1) completion of existing projects in accordance with present Congressional authorizations; (2) development of additional Indian resources requiring authorization by the Congress, and (3) rehabilitation and betterment of existing irrigation systems so as to transfer the operation and maintenance responsibilities from the Government to acceptable water users organizations.

Farm unit development programs are going forward on several of the Indian irrigation projects in Arizona. These programs will materially assist the tribes or the individual Indians in developing their idle land to the point where they can be made part of an irrigation economy. Work under the programs involves establishing farm unit boundaries, clearing, land leveling, drainage, and the construction of internal irrigation systems.

The Indian project power systems are being upgraded through the rehabilitation of the present systems and the installation of up-to-date methods of control which will facilitate the transmission and distribution of the power to the consumer and increase the operating efficiency of the systems.

The water resources associated with Indian trust lands comprise one of the most valuable of Indian assets. The population growth of recent years and the prolonged drought over the past several years have made the control of water supplies subject to acute competition.

Range Resources

Over 86 percent of the Indian land in Arizona is classified and used as range for the grazing of Indian-owned livestock (61,000 cattle, 25,000 horses, 314,000 sheep). The tribal range land, comprising 89 percent of the total, generally is used free by tribal members. However, some of the tribes have already taken or are considering steps to charge their members a grazing fee.

The Navajo and Papago Reservations, representing the bulk of the Indian range, present very difficult management problems due to chronic drought and large numbers of small herds. Since too many Indians are attempting to make a living from their limited range resources, there is severe overgrazing, especially on the Navajo Reservation. One of the major aims of the Department of the Interior's Bureau of Indian Affairs is to develop broader job opportunities so that fewer tribal members will have to depend on stockraising for a livelihood. Good progress in range management has been made on the Hopi, Fort Apache, San Carlos and Hualapai Reservations.

Recreation Resources

Only in recent years have the Indians of Arizona and elsewhere begun to recognize the tremendous income-producing potentialities of well-planned tourist developments on their reservations. In Arizona, these potentials include about 70 percent of the trout streams in the State and many first-rate scenic and historic attractions.

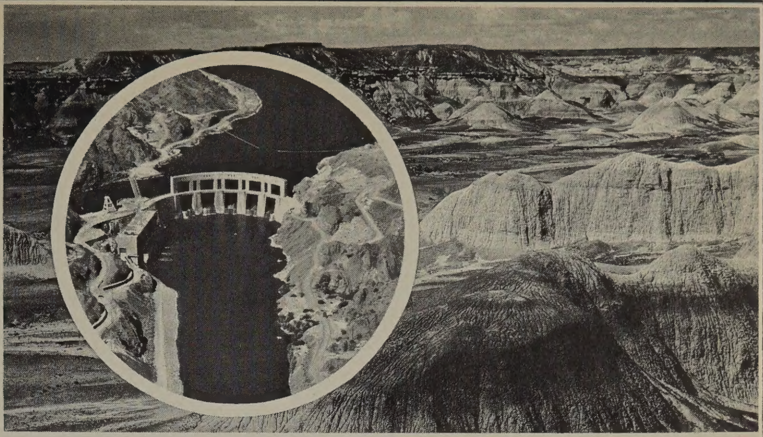
An excellent example of what can be accomplished is the White Mountain Tourist Enterprise on the Fort Apache Reservation. This enterprise is operated by the White Mountain Apache Tribe with help from Federal and State agencies in management practices and enforcement of regulations. It includes over 750 camp and picnic sites located on the reservation streams and lake shores complete with tables, fireplaces and sanitary facilities.

First class tourist facilities such as the Hondah Motel are operated by the tribe. Boat rentals, service stations, trailer parks, grocery stores, and trailer facilities are also provided at several locations. Hawley Lake, in a mountain setting 8,500 feet above sea level, provides the finest fishing and the most complete recreation facilities in the Southwest. These facilities include rental boats, a dock, a grocery store, a tackle shop, a beverage store, a service station, tourist camp, trailer park, and campgrounds. Expansion plans call for a two-story mountain lodge, golf course, riding stables, a ski run and swimming facilities. The Enterprise also has 450 lots available for lease for construction of summer homes.

On other reservations of the State, some of the major developments under consideration or in the planning stage include areas such as the river front on the Colorado River Reservation, the lake to be formed by the Glen Canyon Dam under construction on the Navajo Reservation, and the recreational potential of the Papago Reservation.

The Grand Canyon of the Colorado—Arizona's most noted scenic area—stands as one of the geologic marvels of nature, awe-inspiring in its majesty and grandeur.

Geologic Sketch



THE earliest decipherable history of Arizona began well back in geologic time and is revealed by ancient and contorted schists such as those exposed in the inner gorge of the Grand Canyon of the Colorado River. These ancient rocks are widespread, particularly in central and southern Arizona where they form the cores of many mountain ranges. We know little about these primitive times in Arizona's history except that the rocks of this age were subjected to strong pressures and heat, and were transformed into rocks called gneiss and schist. This early period of mountain building culminated in invasion of these rocks by vast bodies of molten matter that hardened into granite about 1.4 billion years ago. No subsequent deformation surpassed this one in extent and intensity.

As far back as one billion years ago sedimentary rocks were deposited in shallow-water seas throughout much of central Arizona. During most of the following 800 million years the land fitfully rose and the waters drained away, only to have the land sink again and the waters return. At no time were the seas deep, and at no time did high mountains tower above adjacent seas or lakes. Only after prolonged periods of rest did the earth heave slowly to a new position changing seas to land or land to sea. Deposits that accumulated during this long period consisted mainly of sedimentary rocks formed from rounded grains of durable quartz from which most other materials had been winnowed out by the action of the restless water. Much limestone and dolomite also formed from the countless lime-secreting organisms that thrived in the warm seas.

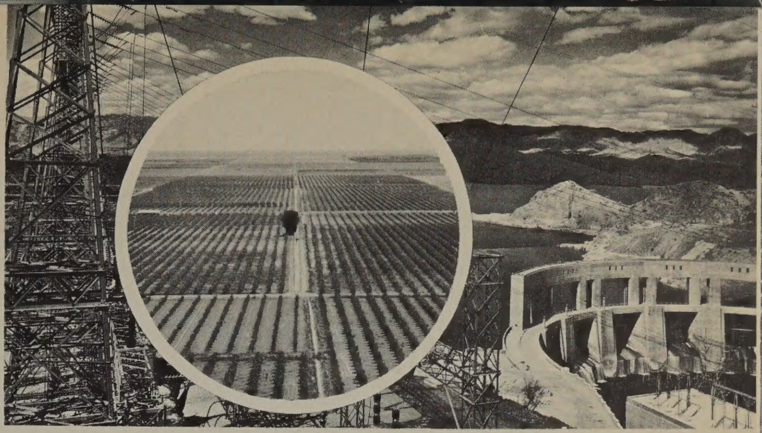
This stable period ended about 225 million years ago at the end of what is known as the Paleozoic Era. With it came the end of relatively uniform geologic conditions throughout the State. Henceforth uniform geologic conditions prevailed only over smaller areas and over shorter periods of time. In northern Arizona much sand and clay, and some gravel, accumulated in shallow seas and on tidal flats. At times, sand dunes were formed. Part of the detritus that formed these sediments came from the central, and perhaps the southern, part of the State where erosion prevailed for about 75 million years.

The geologic history of Arizona subsequent to about 135 million years ago is a composite of many local geologic events. In some areas the sea returned; locally, basins formed which received sediments washed in from the surrounding land areas. Molten rock was intruded into the earth's crust, and in places it broke through to the surface to form volcanoes. At times the rocks were displaced along breaks in the earth's crust, called faults, along which rock masses moved past each other. The landscapes we now see began to develop at least 20 million years ago when the Basin and Range and Colorado Plateau Provinces began to form. At that time, however, the landscapes little resembled those of the present day. These came about through a long, slow period of change.

Phoenix—capital of Arizona—ranks as one of the nation's fastest growing cities. With a population of over 500,000, it is also the heart of the state's industrial empire, and a major tourist resort.

Reservoirs at such dams as Bartlett on the Salt River provide essential water supply for irrigation during periods of high temperatures or no rainfall in Arizona.

Programs of Federal Natural Resource Agencies



Reclamation Programs

ARIZONA is noted as a Reclamation State in which the earliest as well as the latest water resources development projects have put the State's rivers to work. Reclamation's multi-purpose concept was born on the Salt River Project, authorized a year after the Congress passed the Reclamation Act of 1902.

The Theodore Roosevelt Dam on the Salt River was the pioneer effort in multi-purpose construction. Theodore Roosevelt Dam set the multi-purpose principles of modern day Reclamation dams including flood control, water storage and conservation for irrigation, municipal and industrial uses, hydroelectric power generation, recreation, fish and wildlife preservation, and other benefits.

Besides Theodore Roosevelt Dam, some of Reclamation's largest and most beneficial multipurpose dams have been constructed wholely or partly in Arizona. Hoover Dam, half in Arizona and half in Nevada, was completed in 1935 to control the Colorado River for the first time. The river's first structure, Laguna Dam, 13 miles north of Yuma, had been completed in 1909 to divert Colorado River water to the Yuma Project in southwestern Arizona and southeastern California. This dam, however, did not provide the storage and river control so vitally needed to control floods and regulate the river in a year-round flow to prevent droughts. Later, Hoover Dam provided this river control and regulation to assure successful agricultural and industrial development and growth in the Pacific Southwest.

Other Reclamation dams on the Colorado River, partially on Arizona soil, followed the construction of Hoover. These included Imperial Dam and Desilting Works, Parker Dam, Headgate Rock Dam (built by the Bureau of Indian Affairs), Davis Dam and the Palo Verde Diversion Dam. Some 370 miles upstream from Hoover Dam, the Bureau of Reclamation is constructing multipurpose Glen Canyon Dam, entirely within Arizona. Potential multipurpose dams in Marble and Bridge Canyons on the Colorado River also would be constructed entirely within the State.

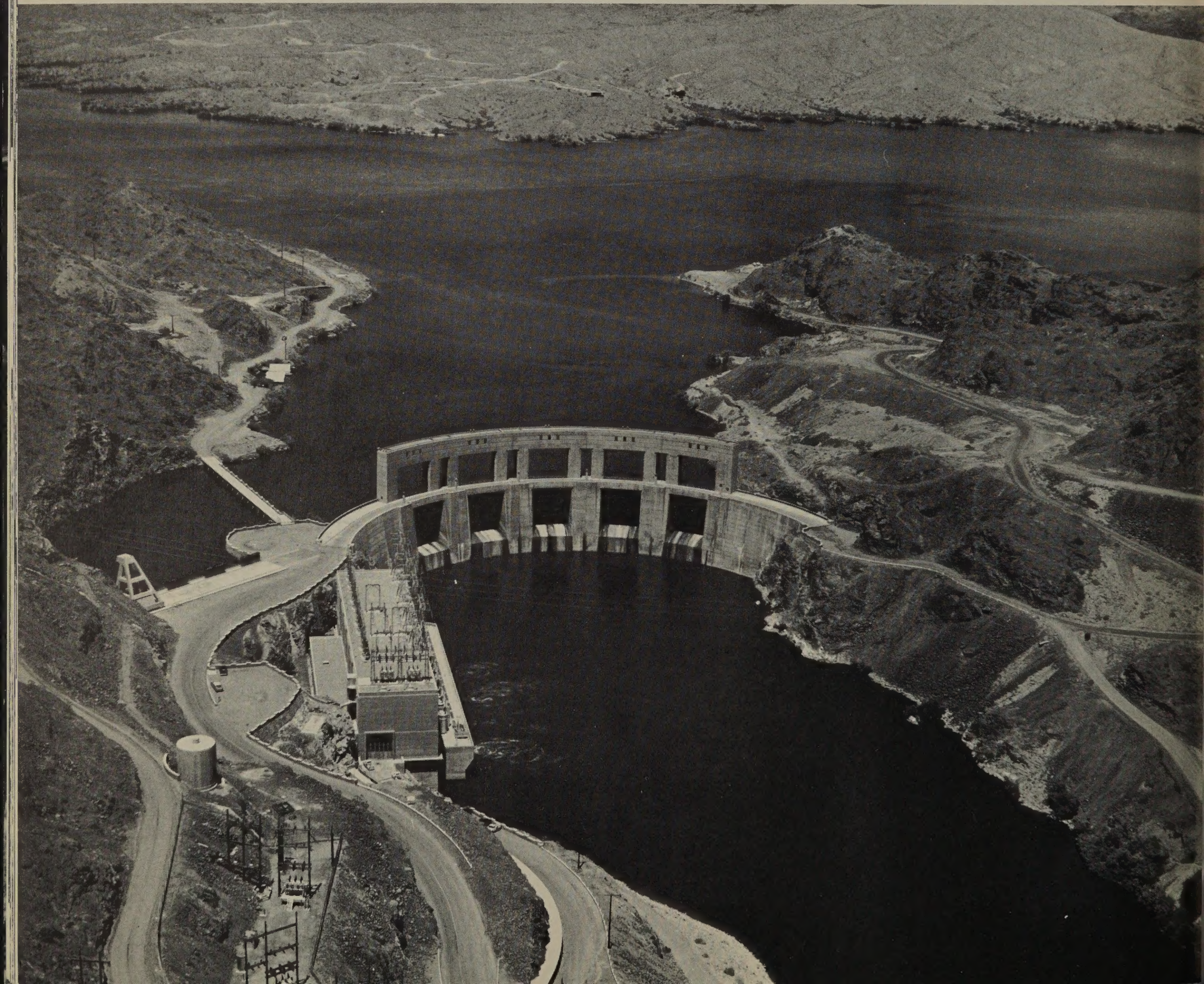
Hoover and Glen Canyon Dams are among the largest and most significant of Reclamation developments. Rising 726 feet above foundation bedrock, Hoover Dam is the western hemisphere's highest dam. Also, Hoover Dam forms the western hemisphere's largest man-made reservoir by volume, Lake Mead. Lake Mead when full to elevation 1,221 feet contains a total of more than 29.8 million acre-feet of water. Glen Canyon Dam, only 16 feet lower than Hoover Dam but containing more concrete, backs up a reservoir, Lake Powell, storing only about 1 million fewer acre-feet of water than Lake Mead.

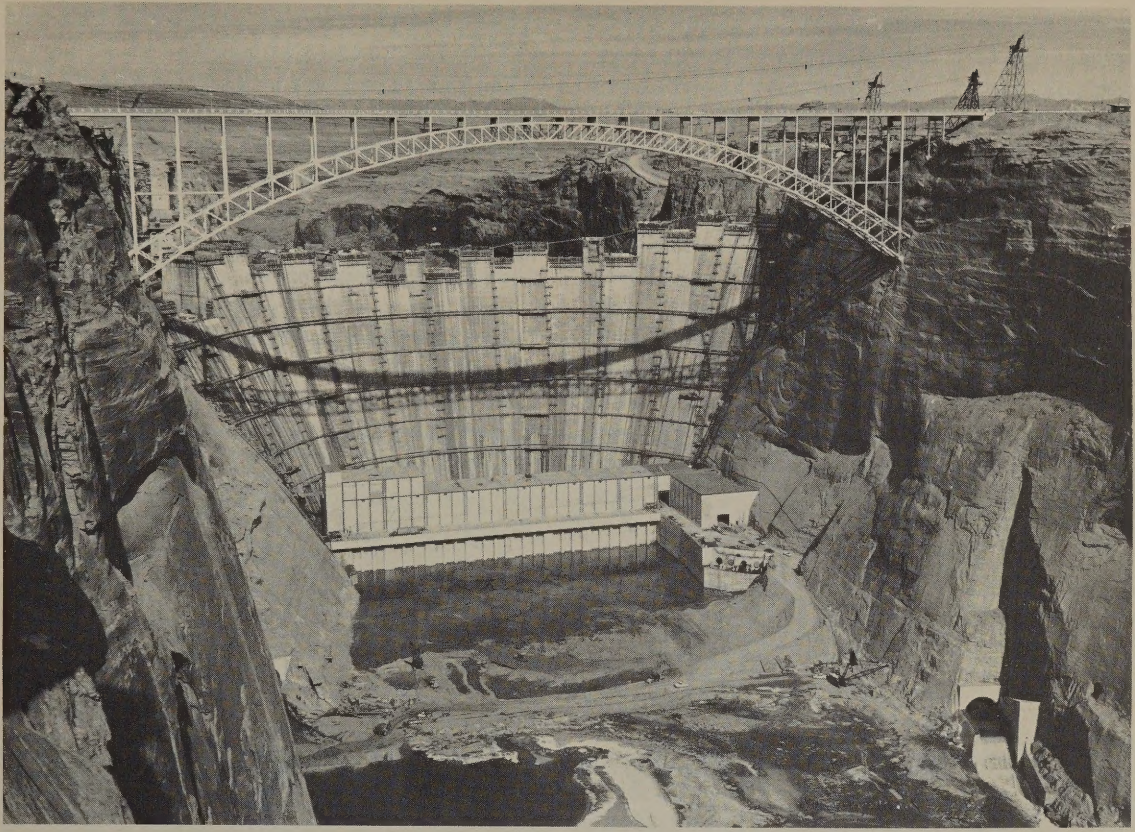
The Salt River Project in central Arizona is the Bureau of Reclamation's largest project in the State. The key features of the project are four dams and reservoirs on the Salt River with a combined capacity of about 1,750,000 acre-feet, two dams and reservoirs on the Verde River with a combined capacity of about 322,000 acre-feet, and a diversion dam below the confluence of the Verde and Salt Rivers. The storage reservoirs are capable of controlling most of the flows of the Salt and Verde Rivers and diversions to the project have averaged over 900,000 acre-feet annually since 1914. The surface water supply is supplemented by pumping from the ground-water basin underlying the area. About one-fourth of the water supply for the project is now obtained by pumping from the ground-water reservoir.

Other Bureau of Reclamation projects within Arizona are the Yuma, Yuma Auxiliary, and Gila Projects in the southwestern part of the State. These projects obtain their water supply by diverting from the Colorado River at Imperial Dam. The waters of the Colorado River available for use by these projects are stored, controlled, and regulated by reservoirs created by Hoover, Davis, and Parker Dams with a combined usable capacity of about 29.2 million acre-feet.

The South Gila Valley in the flood plain at the junction of the Gila and Colorado Rivers just east of Yuma is now obtaining its water supply from wells in the area. This area, comprising the South Gila Unit of the Yuma Mesa Division of the Gila Project, will eventually be served by Colorado River water through the Gila Project system.

Parker Dam is another structure on the Colorado River between Arizona and California.





Located some 370 miles upstream from Hoover Dam, the multipurpose Glen Canyon Dam was built by the Department of Interior's Bureau of Reclamation. Glen Canyon Reservoir—key feature of the gigantic five-state Upper Colorado River Project—will provide irrigation water, power, recreational opportunities, and other benefits.

Additional water is needed in the central Arizona area to supplement the present supply and replace the requirement for pumping from a rapidly diminishing ground-water supply. The Bureau of Reclamation has investigated the potential Central Arizona Project which would deliver supplemental water to central Arizona. Project features include a 736-foot-high concrete arch dam in Bridge Canyon at the head of Lake Mead and an aqueduct system which would deliver pumped water from the Colorado River above Parker Dam into the central and southeastern part of the State.

The Bureau of Reclamation has investigated a proposal to construct a dam at the Buttes site on the Gila River a few miles east of Florence, Arizona. The reservoir would conserve an estimated 50,000 acre-feet annually of flood waters originating downstream from Coolidge Dam to supplement the present deficient supply for the Bureau of Indian Affairs' San Carlos Project in Pinal County. In addition, substantial benefits would accrue for fish and wildlife purposes, recreation, and flood control. The Bureau of Reclamation has also estimated that an additional quantity of about 20,000 acre-feet of water annually would be made available for use on lands in the Safford Valley and areas downstream to and including the San Carlos Project by the clearing of channel vegetation in the Gila River between the head of Safford Valley and the Buttes Reservoir site authorized for construction by the U.S. Army Corps of Engineers.

The Bureau of Reclamation is investigating the feasibility of constructing a multiple-purpose project at the Maxwell Dam and Reservior site on the Salt River just downstream from its confluence with the Verde River. In addition to providing sediment control, flood control, power generation, fish and wildlife and recreational benefits, and regulation of upstream reservoir releases, the project may also conserve some additional water from flood flows originating downstream from the present reservoirs on the Salt and Verde Rivers. The Bureau is also investigating the feasibility of constructing dams and reservoirs at the Marble Canyon and Bridge Canyon sites on the Colorado River between Glen Canyon Dam and Lake Mead principally for power generation for commercial sale and irrigation pumping. Also, these developments would provide substantial fish and wildlife and recreational benefits.

The Bureau has initiated an investigation to determine the possibility of recovering ground water by pumping in the vicinity of Yuma to provide additional water supply. The project would also provide drainage in the area.

In cooperation with the State of Arizona, the Bureau is preparing an inventory of water uses, water supplies, water requirements, and potentialities for future development of the water resources of the State.

Colorado River water, initially stored above Hoover Dam, flows through canals to lands on the Yuma Project, oldest Reclamation development on the river, providing water to the valley's farms the year round.

Geological Survey

THE Geological Survey has an active program in Arizona to complete the topographic surveys of the State. Over 50,000 square miles of Arizona are now mapped with either 7½- or 15-minute quadrangles, and a total area of nearly 30,000 square miles is currently in progress. This large program is the result of high demands for modern topographic maps in Arizona from many Federal agencies, to provide basic data for the numerous resource evaluation and development projects that are underway and anticipated. These maps are also essential to provide for orderly planning at the State and local level for road construction, urban development, mineral exploration and development, water supply and distribution, land use planning, and many other activities generally related to development of the State's resources.

The Water Resources Division of the Geological Survey determines and describes the quantity and quality of Arizona's water, on the surface and underground, whether under natural conditions or under conditions of present or potential development and use by man. Investigations are planned specifically to obtain water information needed to solve major water problems relating to distribution, supply, chemical quality and sediment load, pollution, floods, and variability.

Basic data on streamflow and lake stage are continuously collected at about 165 sites in Arizona. Basic data on the chemical quality of surface waters and on the sediment load of streams are collected at 20 and 16 sites respectively. Ground-water investigations are in progress in the Salt River Valley, Big Sandy Valley, Cottonwood Wash, Willcox basin, San Simon basin, Sycamore Creek basin, and in northwestern Pinal County.

Significant research studies in progress include the following:

1. Evaluation of the hydrologic effect of vegetation modification, particularly the eradication of pinon-juniper and substitution of a grass cover. Study area is the Carrizo and Corduroy Creek basin in the Fort Apache Indian Reservation.

2. Determination of the change in water yield by defoliation and removal of riparian vegetation, chiefly cottonwoods. Study area is Cottonwood Wash near Kingman.

3. Measurement of the use of ground water by saltcedar. Study area is at Buckeye, 25 miles west of Phoenix.

4. Delineation of the factors controlling the hydrology of arid lands and the availability of water to meet increasing industrial and urban demands. This project, which is conducted in cooperation with the University of Arizona, is being carried out in the Rillito Creek basin near Tucson.

5. Hydrologic investigations of the Lower Colorado River basin. It is recognized that, as development of the Colorado River basin proceeds, sound management and equitable allocation of its water resources will be a matter of increasing concern. The investigation will provide urgently needed information on the surface and ground waters of that part of the basin that lies downstream from Davis Dam. Its purpose is to determine hydrologic relationships upon which to base appropriate measures and procedures for managing all the water resources for all foreseeable needs. The plan contemplates intensive studies of the inflow, outflow, and diversions of the river system, evaporation from water surfaces, water losses from phreatophytes (water-"stealing" plants), quantity and movement of underground waters, including that across the line to Mexico, salt transport and balance, and sediment movement.

6. A nontechnical report describing the water situation in Arizona.

Much of the program of water-resources investigations in Arizona is carried out in cooperation with State and local agencies.

At the same time a large number of geologic, geochemical and geophysical studies are being conducted by the Geological Survey in Arizona. They are designed to increase our knowledge of the geologic structure and natural resources. Some are detailed studies concerned in large part with the mineral resources of particular areas. Examples are studies of copper deposits in the San Manuel, Globe-Miami, Pima, and other areas, sedimentary iron ore in the Christmas area, varied mineral deposits in the Patagonia Mountains, asbestos deposits, and the mineral fuels potential of the Navajo Indian Reservation.

Detailed geologic mapping, a fundamental part of most of the studies listed above, is under way also in several other areas in the central and eastern parts of the State. Small scale geologic mapping has been carried on in the State in support of the preparation of a State geologic map by the Arizona Bureau of Mines.

Regional geologic studies are being made of the Arizona part of the Colorado Plateau, including stratigraphic, paleontologic and lithologic studies of certain Mesozoic and Tertiary formations, regional analyses of uranium deposits, and compilation of a geologic map at a scale of 1:250,000.

In the field of geochemistry, a study is being made of the geochemical halos surrounding selected ore bodies to provide increased knowledge of the geochemistry of these deposits and to aid further prospecting and exploration.

Geophysical studies include gravity surveys in the Willcox and Safford basins, regional gravity and magnetic surveys in northeastern Arizona, and seismic and gravity surveys of major crustal structure in the extreme western part of the State.

Unusual experimental studies are under way of diatremes in the Navajo and Hopi Indian Reservations, and similar studies are being made of terrestrial-impact structures in the Meteor Crater area. Being investigated are the origins of several hundred diatremes, the mechanics of eruption, and the differences between craters formed by volcanic action and craters formed by meteorite impact. The studies of terrestrial-impact structures in Arizona are part of a broad program to investigate impact metamorphism and to provide increased knowledge of meteorite impact phenomena.

Information on other geologic work in progress in Arizona can be obtained from the College of Mines, Arizona Bureau of Mines, at the University of Arizona in Tucson.

Information on the various geologic and topographic maps, mineral resources maps, water resources reports, and other geological survey publications relating to Arizona can be obtained by writing the Director, Geological Survey, Department of the Interior, Washington 25, D.C.

Bureau of Mines

THE Bureau of Mines of the Department of the Interior serves Arizona by helping to evaluate its mineral resources and by finding ways to use them effectively. It also works closely with State officials and with both management and labor in efforts to safeguard the health and safety of workers in the State's mineral industries. The Bureau's various programs are conducted both within the State and at major research and testing centers elsewhere. Three offices are maintained in Arizona, two at Tucson and one at Phoenix.

Mineral Resource Surveys

Typical recent surveys of Arizona's mineral resources have disclosed possible markets in nearby States for various minerals. Coal-bearing rocks, for example, were found intermixed with refractory-quality clays and shales that are potentially useful to ceramic manufacturers in California and Colorado as well as in Arizona itself. Continuing studies of mining methods and costs have been reported in technical publications that have proved helpful to mine operators throughout the Nation; those on open-pit and block-caving are particularly valuable to the copper industry. By disseminating information about mineral deposits and the techniques used successfully by industry in extracting and processing metals and nonmetallics, the Bureau is helping Arizonans to utilize their irreplaceable resources as effectively as possible.

Mineral Production and Employment Statistics

Statistics concerning mineral production and employment and accidents in the mineral industries are collected and evaluated by other Bureau specialists in cooperation with the Arizona Bureau of Mines.

Mining Research

Mining research by the Bureau of Mines in Arizona is directed from quarters in the Geology Building of the University of Arizona at Tucson. There Bureau scientists seek improved ways of mining the State's non-fuel minerals. Part of this work is conducted independently by the Bureau and part is carried on in cooperation with the University.

Extensive tests at Arizona's giant San Manuel copper mine are currently being conducted by the Bureau in order to analyze stresses in rock formations surrounding mine openings, particularly the stresses that develop beneath undercuts. This study typifies much of the Bureau's work in that it is based partly upon purely theoretical research conducted in distant installations at College Park, Md., and Minneapolis, Minn. Results of these investigations will be useful not only to the copper industry in Arizona but to mining operations wherever similar types of rock are found.

Metallurgy Research

Metallurgical research in Arizona is conducted at the Bureau of Mines Tucson Metallurgy Research Laboratory, and, in cooperation with the University of Arizona, at the laboratories of the latter. It is chiefly concerned with developing ways to recover minerals from materials that cannot yet be utilized economically. Major efforts have been concentrated upon work with low-grade copper ores because of their great economic importance, but lead, zinc, and complex barite-fluoride ores also have been treated successfully in experiments with Bureau-developed methods.

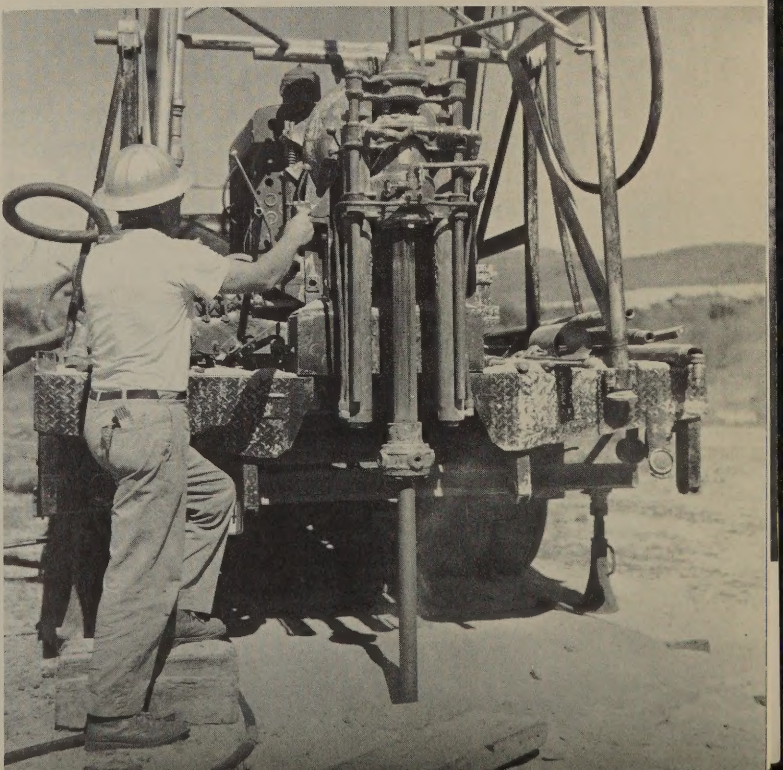
Health and Safety

Bureau of Mines health and safety activities in Arizona are conducted by a staff headquartered at Phoenix which inspects mines and gives training in first aid, mine rescue, and accident prevention. This staff also assists in rescue work at mine disasters and helps protect the State's coal resources with a program for controlling fires that develop in inactive coal deposits.

Petroleum and Bituminous Coal Research

Arizona's newly active petroleum industry and its potentially important bituminous coal industry both have called upon the Bureau of Mines for advice and technological help.

Bureau of Mines Engineers drill for core samples in a continuing program to find promising areas of mineral and fuel deposits.



Bureau of Indian Affairs

THE Bureau of Indian Affairs of the Department of the Interior conducts a wide range of programs designed to conserve and develop the natural resources of Indian lands in Arizona for which the Federal Government has trust responsibilities. In addition to these activities, which are mentioned in an earlier section, the Bureau carries out numerous programs to help in developing the human resources on Arizona's Indian reservations.

Education of young people is one of the Bureau's most important functions, engaging nearly one-half of its personnel and appropriated funds. In Arizona, the Bureau operates one large boarding school in Phoenix and 27 boarding and 35 day or trailer schools on the Reservations. In 1961 these schools enrolled more than 11,000 students. In addition, the Bureau provides instruction for young patients in Indian hospitals operated by the U.S. Public Health Service at Phoenix and Winslow, and operates four dormitories to house Indian children attending public schools of the State.

Adult education programs for the benefit of older Indians who lacked school opportunities in their youth are active in 29 communities on the Fort Apache, Papago, and Navajo Reservations.

The Bureau also provides adult Indians with opportunities to acquire job skills through intensive training in vocational schools or on-the-job courses. For those seeking job opportunities away from the Reservations, it furnishes financial help and practical guidance in relocation.

At the same time the Bureau of Indian Affairs cooperates actively with tribal groups to encourage the establishment of new industries on or near the Reservations and thus expand the job opportunities available to Indian workers.

U.S. Forest Service Programs

THE Forest Service of the Department of Agriculture administers the seven National Forests described earlier in this booklet so that these lands will yield an optimum of benefits—watershed protection, timber, forage, fish and wildlife, and outdoor recreation.

The Regional Forester in Albuquerque, New Mexico, administers the 7 National Forests in Arizona through the respective Forest Supervisors and their staffs. Two of Arizona's National Forests, the Apache and Coronado, extend into the adjacent State of New Mexico.

With use of the National Forests increasing yearly, it became necessary to intensify management and protection activities to avoid deterioration of existing resources and facilities through overuse. To insure that the National Forests will ably meet the demands of the future, the Forest Service embarked on a "Development Program for the National Forests" aimed at developing and managing all resources for the anticipated demands by 1972 and including long-term planning for the year 2000.

Forest and Range Research

The Forest Service administers field research centers at Tempe, Flagstaff, and Tucson; experimental ranges at Fort Valley, Sierra Ancha, Santa Rita; and timber research centers at Mt. Graham and Long Valley. All are a part of the research program of the Rocky Mountain Forest and Range Experiment Station which has headquarters in Fort Collins, Colorado.

Research has shown ways to improve range management. Cattle can be distributed more evenly over the range by careful location of fences and water developments. More vigorous growth of grass can be achieved through rest rotation grazing and new methods of eradicating undesirable range plants. Research also contributes to more effective rodent control.

Other research programs carry on the constant fight against forest insects and diseases, seek improved methods of firefighting, study wildlife habitat, forest regeneration, and timber management.

One of the most important research projects is a vast cooperative water resource study by the Forest Service, State Land Department, Arizona Water Resource Committee, many interested State and private agencies, and individuals. Initiated just five years ago it is now a full-scale program yielding tangible results.

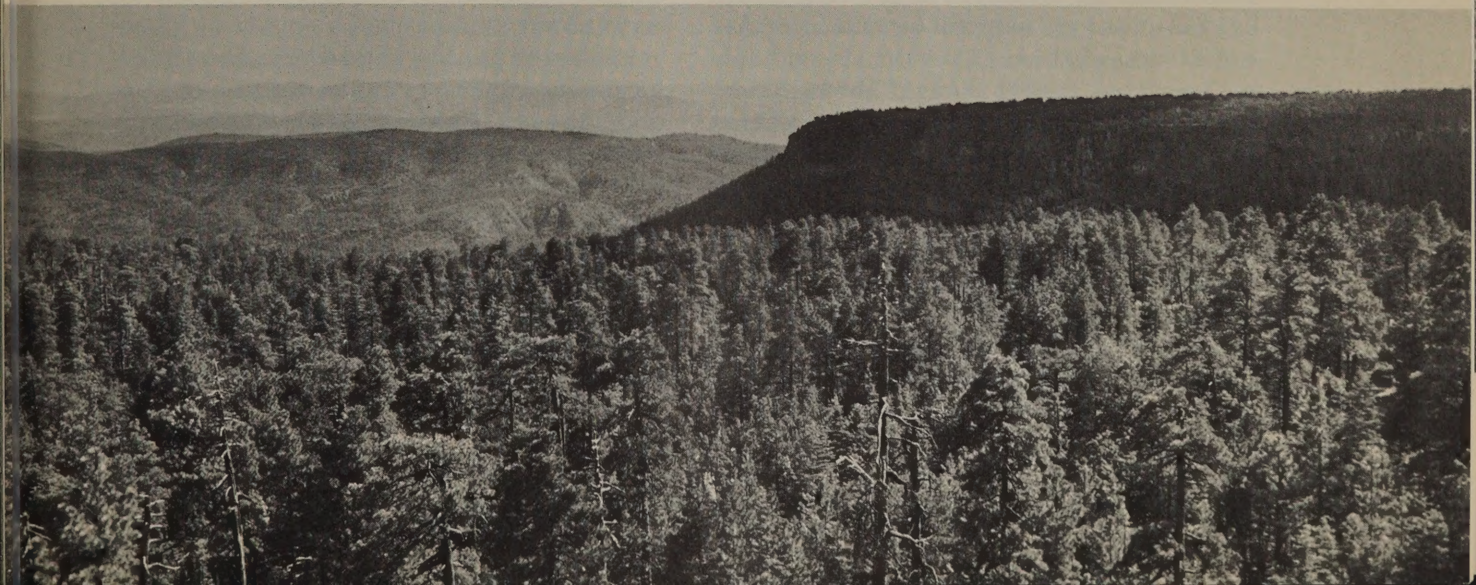
The Forest Service is trying out various land treatment measures in the Coconino National Forest on the Beaver Creek Project, a part of the Salt River watershed which contributes about two-thirds of the annual water requirement of the Phoenix area. Through the land treatment being carried out on the Beaver Creek Project the Forest Service seeks to determine how different types of vegetative cover on the land effect water yield, water quality, and erosion rates.

Experiment and control areas have been developed to ascertain the type of land treatment which is best for high water retention of the land. Specifically, these experiments include thinning overstocked stands of young ponderosa pine, converting non-commercial pine into grassland, removing pinyon and juniper; and evaluating effects of these treatments on water yield. At the same time the Salt River watershed is being intensively managed for full and wise use of all resources.

Sustained yield management of Forest Service lands assures a continuing supply of Arizona timber.

Access roads for lumbering in Arizona's National Forests are often used for recreational purposes when logging operations are complete.

The 12 million acres of National Forest Service lands in Arizona are managed for multiple purposes—such as timbering, watershed protection, wildlife enhancement, and outdoor recreation.



Bureau of Land Management Programs

As steward of the national land reserve in Arizona, the Bureau of Land Management of the Department of the Interior conducts programs which touch almost daily on the lives of residents and tourists alike.

The agency is responsible for the management of land-based resources on 15 million acres of Federally-owned land, nearly 13 million of it in four management districts. Its programs are concerned with wildlife, livestock grazing, watershed management, recreation, minerals, forestry, and such attendant duties as fire control, range conservation and improvement, land survey and land disposition. As custodian of the public domain, BLM also has some responsibilities on lands under the direct management of other agencies.

It is estimated that 70,000 big game animals range on the national land reserve in Arizona during all or part of each year. The desert mountain ranges in the western parts of the Kingman and Maricopa management districts are home for almost all of the State's rare Desert Bighorn sheep.

In addition to big game, national land reserve areas support large numbers of upland birds and other wildlife. Watering places developed by the Bureau of Land Management and grazing permittees have provided new habitats and better distribution of game animals. The many reservoirs and waterspreading systems also provide resting places for migrating waterfowl.

BLM range managers are vitally concerned with the forage and habitat needs of wildlife. Proper balance between use by wildlife and domestic livestock and with other uses requires careful consideration. Conflicts in multiple use are being rapidly resolved through close working relations between the Bureau of Land Management, the State Game and Fish Department, and others who have interests in the public lands. An example of such cooperation is an agreement which provided for the re-introduction of antelope in the Arizona Strip management district.

Many acres of the national land reserve in Arizona suffer from varying degrees of erosion. Erosion processes have been speeded up by removal or change in the original plant cover as a result of overgrazing, fire, weather, or other causes. The BLM range conservation and improvement program is directed to restoring adequate vegetation on deteriorated ranges.

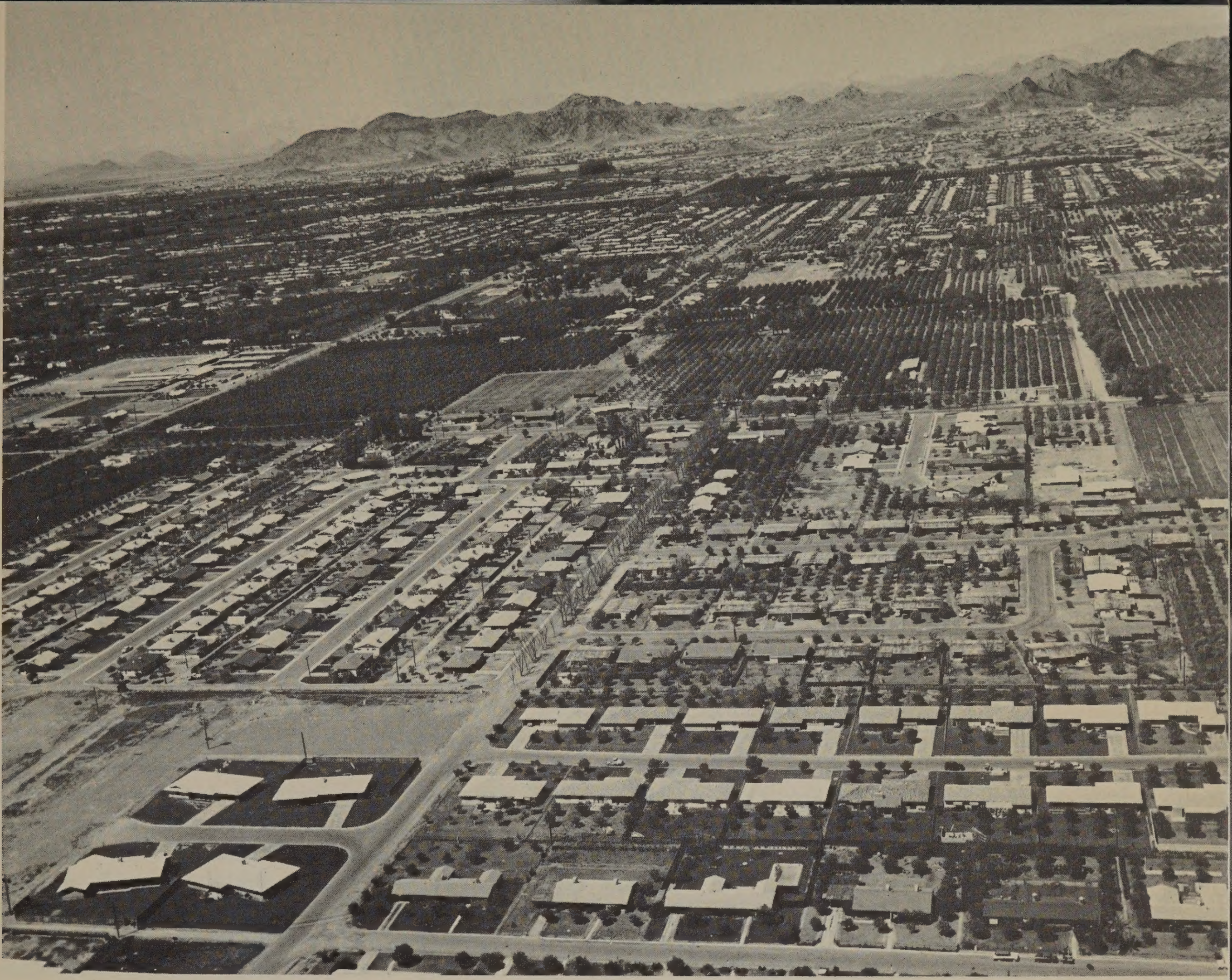
Detention or diversion structures are built to reduce the destructive force of wild water and to take the peak off of flood crests. These waters are released by controlled flow to waterspreading areas or to the original channel for the benefit of downstream users. The BLM has built 70 detention or diversion dams, and over 320,000 lineal feet of diversion dikes in its program in Arizona.

Over 122,000 acres have been improved by brush removal or a combination of brush removal and seeding. BLM cooperates with the University of Arizona in research on new methods of seeding semi-arid rangelands. Fencing is one of the most important tools used in range rehabilitation. BLM or its permittees have built 4,700 miles of fence on the national land reserve, enough to fence both sides of a highway from Phoenix to Miami, Florida.

Important contributions to outdoor recreation are being made on the national land reserve. Millions of acres are used for extensive recreation including hunting, fishing, camping, hiking, and picnicking. An inventory of BLM lands having special attractions which make them suitable for intensive public recreation use continues. Lands having important multiple-use value are retained in Federal ownership but are made available to State or local agencies by lease, permit, or agreement.

Lands with primary values for local recreation use can be acquired by local governments. For example some 70,000 acres of national land reserve have been leased to Maricopa County for a series of regional parks surrounding the greater Phoenix area. Multiple use, including hunting and forage production, are insured by agreements and terms of the leases.

The Bureau of Land Management administers the mineral leasing and mining laws on Federal lands in Arizona. The agency investigates



The population growth of Arizona's cities has caused a spread of housing developments to move into lands previously used for irrigated agriculture. Bureau of Land Management programs assist in putting public lands in municipal hands for recreation, public works, public health, and educational use.

patent applications under Federal mining laws for gold, copper, tungsten, and other minerals. Mineral claims in conflict with surface uses are examined and improper claims are invalidated.

BLM is responsible for fire protection on nearly 14 million acres. To keep fire losses at a minimum, the Bureau of Land Management has undertaken a program of fire prevention and suppression which ranges from public education to modern fire suppression techniques. Most fires are range fires on flat grassland or in relatively inaccessible mountain chaparral areas. On BLM lands adjacent to National Park and National Forest areas, cooperative agreements insure prompt detection and suppression action. Burned areas are reseeded where conditions appear favorable.

BLM is responsible for land surveys on the national land reserve and on an additional 11 million acres of public lands administered by other Federal agencies. Records of all of the cadastral surveys in Arizona are maintained by the Bureau in its state office in Phoenix.

Arizona leads a fast-growing Nation in the rate of population increase with a growth of 959 percent since the year 1900. The burden of meeting many needs for space and resources falls on the national land reserve. In many cases the growth of mining, housing, recreation, and school facilities depends on BLM lands. Prudent transfer of land to State and local agencies and to individuals is instrumental in the growth of municipalities. Proper management of all of these lands is vital to the economic and social well being of the State.

National Park Service Program

THE National Park Service administers Grand Canyon National Park as well as sixteen National Monuments—more than any other State—which have been described earlier in this book.

The completion of the Glen Canyon project (Arizona-Utah border) will open to public use still another portion of the spectacular canyon country of the American Southwest. Glen Canyon, is one of the nineteen major gorges of the Colorado.

The National Park Service plans to build several campgrounds above the dam, with lodges, restuarants, and boat-launching facilities, and the lake itself will afford a vast area for boating and other water sports.

For campers, the canyon country is virtually unsurpassed in its attractions. There are no mosquitos.

Under a continuing long-range program of development of areas in the National Park System, the Service is rolling along in its improvement plans for Arizona areas. For example, the fascinating Visitor Center at Petrified Forest has been adapted from Indian architecture. Surely, the Indian of the Southwest must feel more and more at home in his native land as his American brothers forsake the architecture common to other parts of the country and adopt the Indian style of architecture so well-suited to the climate. The "timeless" Indian style is good design and is reflected in the public use facilities at Petrified Forest.

Fossilized trees lie scattered over the desert in Arizona's Petrified Forest National Monument. Trails wind through the Third Forest, where fallen trees of tremendous girth are seen against a background of eroded mesas.

Other Park Service conservation and development programs in Arizona include: Visitor Centers and campground development (particularly at Navajo); the extension of the launching ramp to low water at Lake Mead as well as harbor dredging there; construction of trails and walks; the construction of the Tusayan airport near Grand Canyon National Park; and the improvement of trails into the canyons to insure safe hiking for those visitors who are interested in seeing the canyons by foot travel.

Continuing Park Service work at the Grand Canyon includes: Training Center Utilities; South Rim Utility Buildings; work on the Entrance Station at Desert View; and the construction of roads and parking areas.

Many of the Arizona National Monuments are day-use areas.

Consequently, the Park Service's continuing development plans call for grounds improvement; picnic areas; extension of water lines to picnic areas; comfort stations; and trailside shelters with interpretive devices.

By 1966, Park visitors to the State of Arizona will find many projects completed for public use and enjoyment as well as interpretation of the parks and monuments. There will be improved roads and trails, campgrounds, picnic tables, information centers and visitor centers.

However, the real accomplishments of the Park Service's long-range programs are measured, not by acres of campgrounds, not by miles of new roads, increased capacities of lodges, or by the number of new public buildings, but by how well the program as a whole accomplishes the purpose of National Parks—to preserve the Nation's heritage in wild lands, scenery, and historic treasures for the enjoyment and inspiration of Americans.

Pronghorn antelope still roam the prairies near Grand Canyon National Park.

Fish and Wildlife Service Programs

THE Fish and Wildlife Service has two Big Game Ranges in Arizona which it operates in cooperation with the Bureau of Land Management, two National Wildlife Refuges, one National Fish Hatchery which has been in operation for years and two which are under construction. It conducts a program known as Fishery Management Services which has already added 300,000 fishermen-days a year to Arizona's sport fishery resource on seven Indian Reservations. It conducts an effective program of predator and rodent control which not only protects the farmer, the miller, and others from rodent damage, but also benefits wild and domestic animals by preventing explosive build-ups of predators. It conducts studies to help fit the fish and wildlife resources to changing conditions. It enforces Federal game laws and performs numerous other services in co-operation with the appropriate State or local authorities.

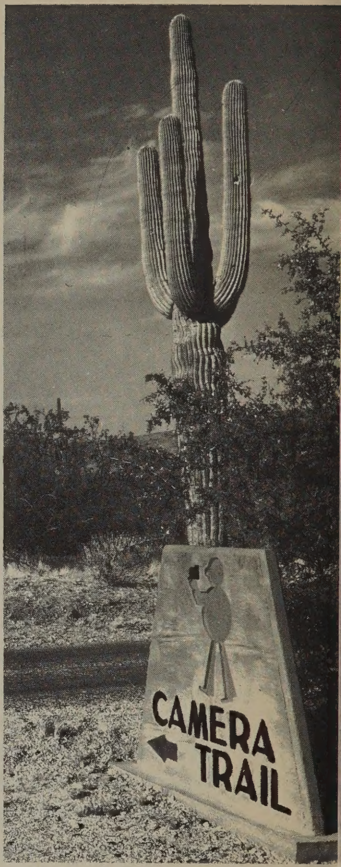
The Fish and Wildlife Service's Williams Creek National Fish Hatchery, located in the White Mountains on the Fort Apache Indian Reservation produces only rainbow trout. Its output in 1960 was 87,421 pounds. A cooperative agreement between the Fish and Wildlife Service, the White Mountain Apache Tribe, and the Arizona Game and Fish Department provides for coordinated efforts in operating the hatchery and distributing its products.

The two new National Fish Hatcheries have been planned: Willow Beach, an $850,000 project, and Alchesay, the cost of which is estimated at $913,000. Willow Beach, located about 14 miles below Lake Mead, has started production. Primary area of distribution of its annual production of some 200,000 pounds of trout will be the Lower Colorado River, under cooperative agreements with the Fish and Game Departments of Arizona, Nevada, and California. Alchesay is under construction on the Fort Apache Indian Reservation about 12 miles north of Whiteriver. Production, which is expected to range in the neighborhood of 100,000 pounds annually, is scheduled to begin in 1964.

The Big Game Ranges, Cabeza Prieta and Kofa, were reserved from public domain land for the protection of native fauna and flora, especially desert bighorn sheep. The Cabeza Prieta, located in southwestern Arizona near the Mexican border, encompasses 860,040 acres. Situated about 30 miles northeast of Yuma, the Kofa Game Range includes 660,041 acres.

Havasu Lake and Imperial National Wildlife Refuges, both located along the Colorado River, were established to benefit migratory waterfowl. The respective acreages are 45,761 and 46,791. These refuges serve an important role in the preservation of the remnant flock of Great Basin geese.

Water skiing offers thrills and fun at Lake Mead National Recreation Area. Other newer areas, such as Glen Canyon, will provide increased water-based outdoor recreation in Arizona.



Bureau of Outdoor Recreation

ALTHOUGH the Bureau of Outdoor Recreation manages no land, its functions serve to increase the supply of outdoor recreation opportunities within Arizona, for the benefit of State citizens and tourists.

The Bureau provides technical services and planning and survey assistance in outdoor recreation to State and local governments. It also assists in preparing standards for Statewide recreation plans, and upon authorization by Congress, will administer Federal financial grants-in-aid for State recreation planning, acquisition and development.

The Bureau, created by Presidential Order and established in the Department of the Interior in the spring of 1962, correlates related outdoor recreation programs of the various Federal agencies and bureuas operating in Arizona. It is responsible for formulating a nationwide outdoor recreation policy and plan, based on State, regional and Federal plans. The Bureau sponsors and conducts recreation research, and encourages interstate and regional cooperation in outdoor recreation projects.

U. S. Army Corps of Engineers Programs

THE United States Army's Corps of Engineers is charged with public civil-works programs to control, regulate, and improve river and harbor resources, to administer laws pertaining to the preservation of navigable water, and to plan, construct and operate flood-control works.

In the State of Arizona, the U.S. Army Corps of Engineers civil-works program involving water-resources development is confined almost entirely to flood control and to related water-conservation, recreational, fish and wildlife, and hydroelectric development. No Federal river-and-harbor projects are in Arizona.

Eight projects for flood control and for related purposes have been authorized for construction by the U.S. Army Corps of Engineers in Arizona. Four of these projects have been completed:

The first, a flood-control levee on the Little Colorado River at Holbrook; the second, a detention basin and outlet channel on Trilby Wash; the third, the Painted Rock flood-control reservoir on the Gila River; and the fourth, the Whitlow Ranch flood-control reservoir on Queen Creek. The Trilby Wash project was constructed by the Corps of Engineers serving as the construction agency for the U.S. Department of the Air Force.

The authorized but uncompleted projects are the Alamo Reservoir on the Bill Williams River, the Camels Back Reservoir on the Gila River, the middle Gila River channel improvements, the Tucson diversion channel, the Gila and Salt Rivers levee and channel improvements, the Gila River and tributaries downstream from Painted Rock Reservoir, and Pinal Creek and tributaries.

Completion of all projects authorized for construction by the U.S. Army Corps of Engineers in Arizona would provide (a) protection against floods for important areas in the Queen Creek drainage area, along Trilby Wash and adjacent streams, along the Gila and Salt Rivers, along the lower Bill Williams River, and along the Little Colorado River, as well as for Tucson and vicinity; and (b) protection for lands along the lower Colorado River and in the Imperial Valley, Calif., from floods on the Bill Williams River and the Gila River. In some cases, provisions would also be made to conserve floodwaters for beneficial use and to develop recreational areas.

Further projects may be added to the Corps' authorized program from time to time in response to area needs. Typically, such needs are brought to the attention of the Congress, which may direct the Corps to conduct an appropriate study to find ways of meeting the problems. After engineering, economic, and other needed investigations, which may include the holding of public hearings, findings are reviewed, submitted to State and Federal agencies, and finally, transmitted to Congress. Congress may authorize the project for construction, or may incorporate it for authorization into a comprehensive basin plan. After authorization, the project will be designed and built in accordance with the authorizing act at a time and rate determined by the appropriation of funds by Congress.

At present Congress has directed the Corps to make investigations and reports on flood control and related problems in various drainage areas in Arizona. These include the Colorado River Basin above Lee Ferry; the Virgin River Basin, and the Little Colorado and Gila River Basins. Some of these investigations have been completed and the reports are before Congress. Others are in progress, and, as funds are made available, will be completed and submitted to Congress for its decision as to future action.

The U.S. Army Corps of Engineers is also charged with the responsibility of formulating rules and regulations for the use of space allocated to flood control at all reservoirs constructed wholly or in part with Federal funds. In carrying out that responsibility, the U.S. Army Corps of Engineers—in cooperation with the Bureau of Reclamation—has developed rules and regulations for operating flood-control storage space at Hoover Dam and—in cooperation with the Bureau of Reclamation and the Bureau of Land Management—is evaluating the flood-control aspects of reservoirs proposed by those agencies as a basis for determining whether flood-control storage space should be allocated in those reservoirs.

Projects Completed

Holbrook levee. The Holbrook levee was completed in December 1948. The levee, which extends for about 6,200 feet along the north bank of the Little Colorado River at Holbrook, protects about 95 percent of the city of Holbrook from floods of up to 60,000 cubic feet per second, which is equal to the greatest flood record.

Flood damages prevented by the project since its construction are estimated at $130,000 (1960). The project would prevent damages estimated at $830,000 (1960) if a project design flood should occur.

Trilby Wash detention basin (McMicken Dam) and outlet channel. The Trilby Wash detention basin and outlet channel was completed in July 1956. In November 1956, it was dedicated as *McMicken* Dam. The project includes a detention basin on Trilby Wash about 20 miles west of Phoenix, Ariz., and an outlet channel to convey flood releases from Trilby Wash detention basin toward the Agua Fria River.

The project provides complete protection from floods originating upstream from the detention basin to the Luke Air Force Base, the Litchfield Park Naval Air Facility, the Goodyear Aircraft Co. plant, and the towns of Goodyear, Litchfield Park, and Avondale, and to about 50,000 cultivated acres of intensively developed agricultural land.

Flood damages prevented by the project since its construction are estimated at $600,000 (1960). The project would prevent damages estimated at $5,000,000 (1960) if a project design flood should occur.

Painted Rock Reservoir. The Painted Rock Reservoir was completed in December 1959. The Reservoir is formed by a rolled-earthfill dam on the Gila River at river mile about 20 miles northwest of Gila Bend. The dam, which is 181 feet high and about 4,796 feet long, creates a reservoir of 2,491,700 acre-feet at spillway-crest elevation, including 200,000 acre-feet for sediment.

The reservoir provides protection from floods originating above the reservoir site to about 360,000 acres in the downstream overflow area along the Gila River from the damsite to the Colorado River, along the Colorado River from Laguna Dam to Mexico, and in the Imperial Valley, Calif. About 200,000 acres of intensively developed irrigated land are in the overflow area. In addition, about 100,000 acres of intensively developed irrigated land outside the overflow area are protected from potential damage.

If a project design flood should occur, the proposed improvement would prevent damages estimated at $65,000,000 (1960). This project is an important unit under the overall flood-control plant for the lower Colorado River.

Whitlow Ranch Reservoir. Whitlow Ranch Reservoir was completed in October 1960. The reservoir is formed by an earthfill dam on Queen Creek at stream mile 43, approximately 40 miles southeast of Phoenix. The dam has a maximum height of 149 feet above streambed and a crest length of 837 feet. The reservoir has a total storage capacity of 35,890 acre-feet at spillway crest, of which 7,000 acre-feet are allocated for sediment.

The project would prevent damages estimated at about $8,900,000 if a project design flood should occur.

Project Under Construction

Middle Gila River channel improvements, upper end of Safford Valley to Buttes Reservoir site, Gila River Basin, Ariz. This is one of the units under a comprehensive plan for development of the Gila River. Other units, including a reservoir at the Camelsback site and one at the Buttes site, are subject to further detailed study and specific authorization.

Gila and Salt Rivers levee and channel improvements. This plan of improvement provides for (*a*) a levee extending downstream for about 2,000 feet along the left bank of the Salt River from Tempe Butte, just upstream from Tempe, Ariz., to the Southern Pacific railroad embankment; (*b*) a levee extending downstream for about 16,700 feet along the right bank of the

Salt River from the Southern Pacific railroad embankment to 40th Street, Phoenix, Ariz.; (*c*) a 2,000-foot-Dam to Gillespie Dam; and (*d*) two low-flow channels, one in the cleared floodway of the Salt River upstream from the highway bridge at Tempe, and the other in the cleared floodway from the Gila River between Gillespie Dam and a point downstream from the Agua Fria River.

The improvement would provide complete protection against the standard project flood for most of the city of Tempe and part of the city of Phoenix and partial protection for additional areas in Phoenix, for adjacent developed areas, and for other areas. Because of the clearing of phreatophytic weed growth from the floodway, the improvement would also result in a net annual increase of 16,000 acre-feet of water available for agriculture.

The project would prevent damages estimated at about $5,700,000 if the standard project flood should occur. In addition, the average annual benefits accruing from the removal of phreatophytic growth and the resultant increase in water available for agriculture are estimated at $148,000.

The plan of improvement provides for a cleared floodway extending for about 94 miles along the middle Gila River. The floodway would be created by clearing phreatophytic weed growth from an area of about 14,200 acres with a maximum width of about 4,000 feet and an average width of about 13,000 feet. The improvement would provide partial protection from floods to areas in the Safford Valley and, because of the removal of phreatophytic growth, would result in a net annual increase of 19,800 acre-feet of water available for agriculture.

Although the project is designed to operate independently of any other flood-control improvement, it is also designed to operate even more effectively in conjunction with Camelsback Reservoir, one of the improvements under the comprehensive plan now under study. However, even when operating independently, the project would still prevent (*a*) average annual damages estimated at $98,000 and (*b*) damages estimated at about $440,000 if a project design flood should occur. Water available for agriculture is estimated at $275,000 annually.

Authorized Projects not Started

Alamo Reservoir. The plan of improvement provides for the construction of a dam on the Bill Williams River, about 38 miles above the junction of the Bill Williams and Colorado Rivers. Tentative plans provide for a concrete-arch dam about 294 feet high above streambed. The crest of the dam would be about 695 feet long, and the reservoir created by the dam would have a total capacity of 1,077,000 acre-feet (including 150,000 acre-feet for silt storage) at spillway-crest elevation.

Although the reservoir is designed to operate initially to control floods and sediment only-provision is made in the project plans for future water-conservation storage and power production. Furthermore, consideration is being given to development of Alamo Reservoir as a recreational area.

The project would prevent damages estimated at about $9,500,000 if a project design flood should occur.

Tucson diversion channel. The plan of improvement as presently modified provides for (*a*) diversion of standard-project-flood discharges from the upstream part of the Tucson Arroyo drainage area to the contiguous Julian Wash drainage area by increasing the capacity of the diversion-channel project that was partly completed by Pima County; and (*b*) conveyance of the diverted floodflows and of standard-project-flood discharges along Julian Wash to the Santa Cruz River by constructing an improved channel from the diversion-channel outlet to the river.

The project would prevent damages estimated at about $8,500,000 if a project design flood should occur.

Further details are available in a brochure, "Water-Resources Development by the U.S. Army Corps of Engineers in Arizona," which may be obtained by writing the Division Engineer, U.S. Army Engineer Division, South Pacific, P.O. Box 3339, Rincon Annex, San Francisco 19, California.

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SUMMARY

Arizona—the Grand Canyon State—is, as you have seen from this booklet, an area rich in natural mineral resources; an area where the hand of man has provided the water resources for the development of rich agricultural lands; an area of rich scenic beauty and contrasts of mountains and deserts whose rich recreational potential is only now beginning to be realized.

One of the fastest growing States in the Nation, Arizona has learned the hard way that conservation and wise use and development of resources of land and water mean sound and continuing progress, and its face is now set brightly toward the sun.

The Department of the Interior, the U.S. Forest Service, and the Corps of Engineers have played an important role in furthering Arizona's growth and progress, and this role will be increased and strengthened in the years to come.

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The Natural resources of Arizona.

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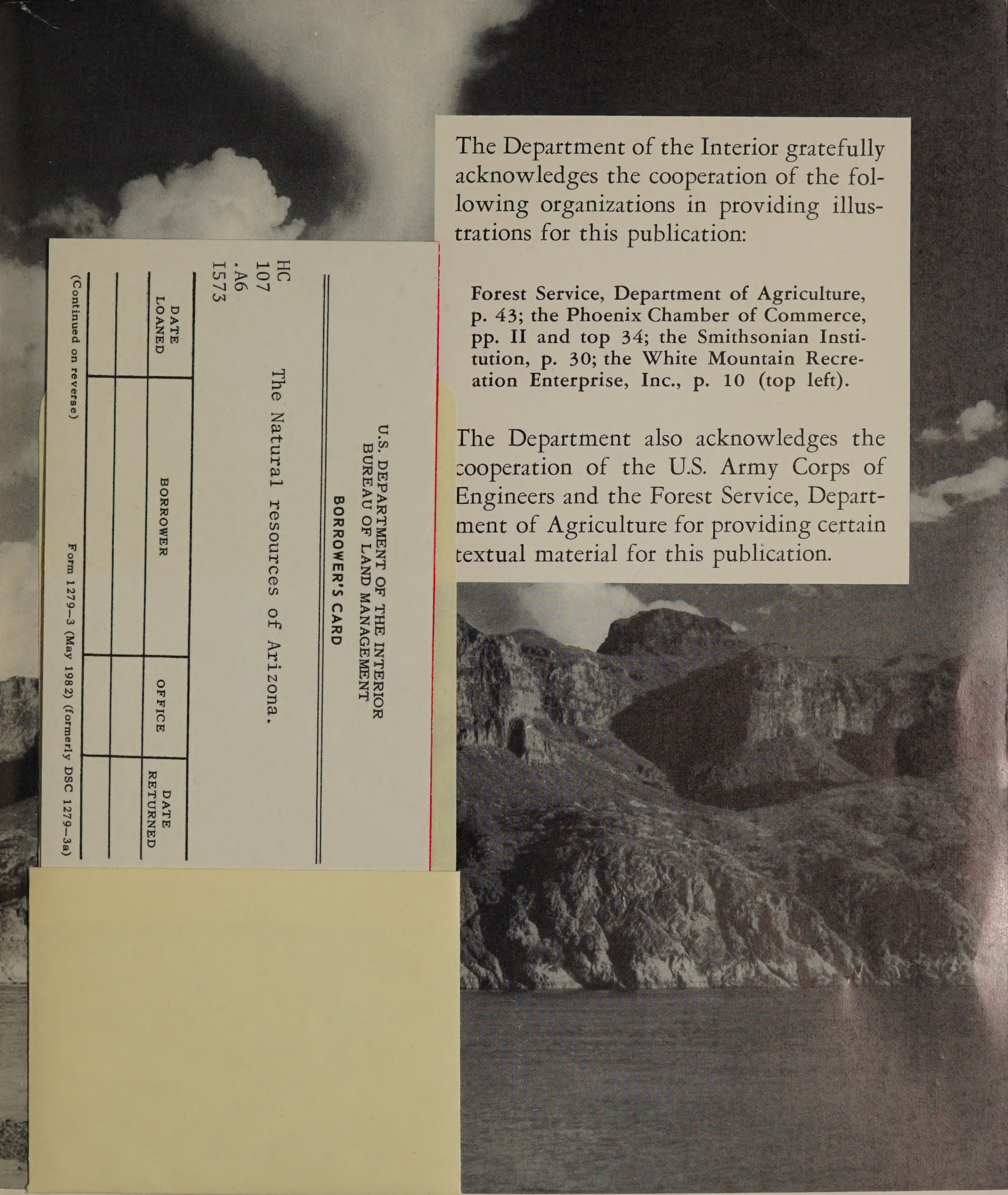

The mighty Colorado.

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GREAT SEAL OF THE STATE OF ARIZONA
1912

Created in 1849, the Department of the Interior—a Department of Conservation—is concerned with the management, conservation, and development of the Nation's water, fish, wildlife, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

As the Nation's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States—now and in the future.

March 3, 1849